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ANNUAL REPORT OF THE  
ISTHMIAN CANAL  
COMMISSION

FOR THE FISCAL YEAR ENDED JUNE 30

1913



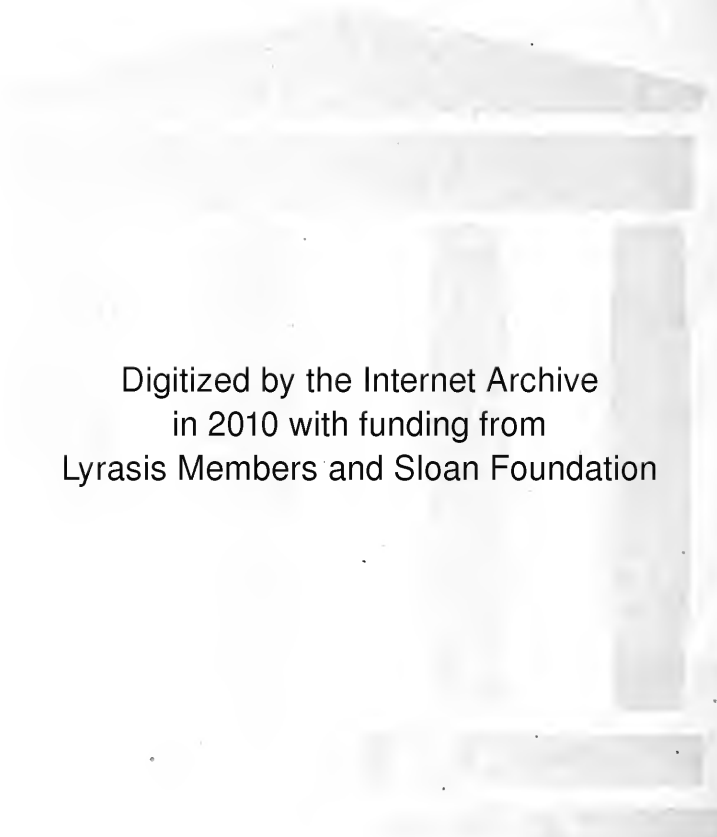
WASHINGTON

1913





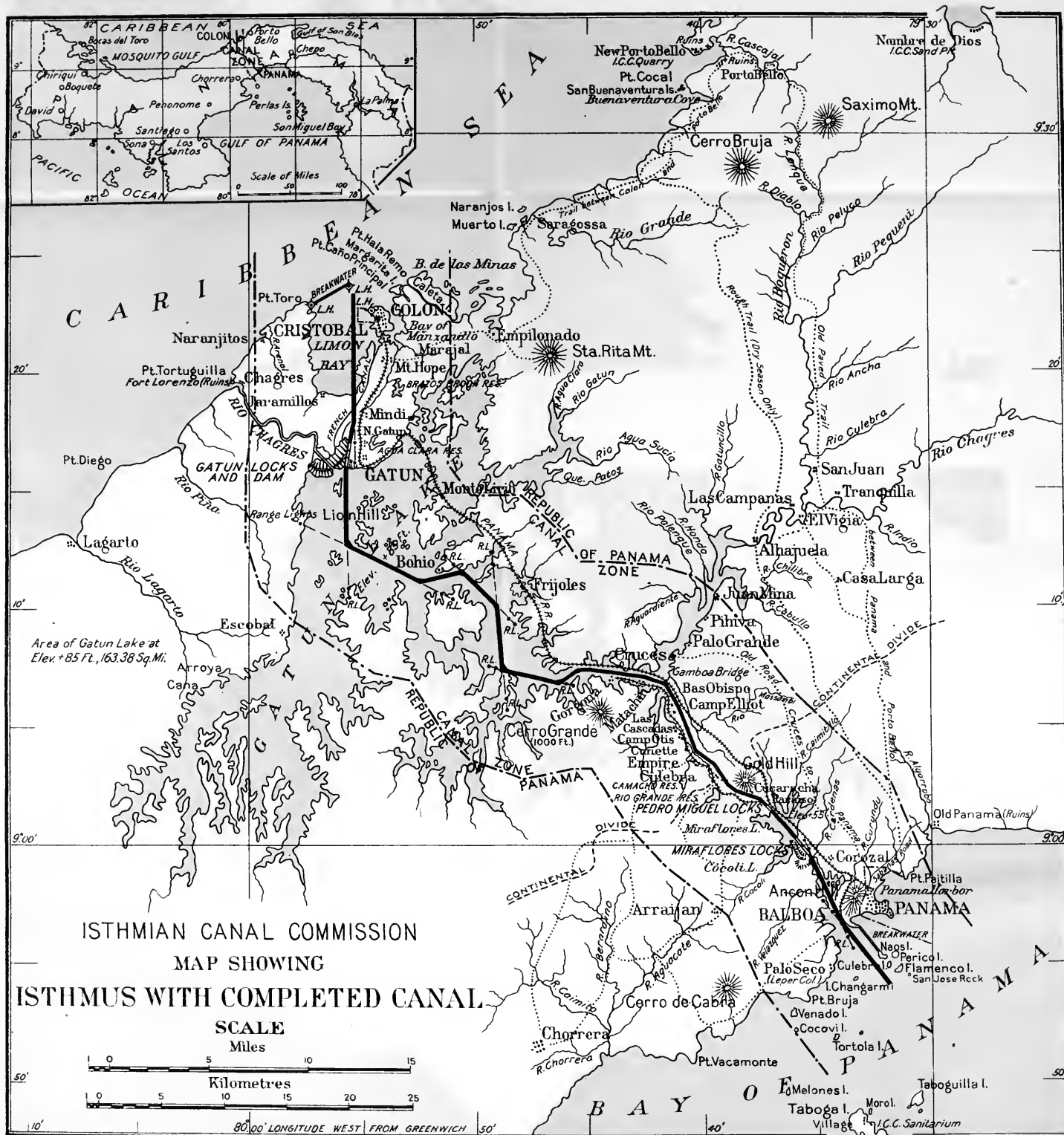




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WASHINGTON

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[Report of the chief engineer of the Panama Railroad relocation.]

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[Report of geologist.]

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ANNUAL REPORT  
OF THE  
ISTHMIAN CANAL COMMISSION.

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ISTHMIAN CANAL COMMISSION,  
OFFICE OF THE CHAIRMAN,  
*Culebra, Canal Zone, September 15, 1913.*

SIR: I have the honor to submit the annual report for the Isthmian Canal Commission for the fiscal year ended June 30, 1913.

ORGANIZATION.

The organization continued as outlined in previous annual reports, with but minor changes, until January 1, 1913. Mr. S. B. Williamson, division engineer of the Pacific division, concluding that the work of his division had advanced to such a state that the commission was not warranted in continuing his position, tendered his resignation, effective December 11, 1912; and it was reluctantly accepted. This action necessitated a reorganization of the work on the Pacific side. That part of it relating to the terminals, which during the previous fiscal year had been assigned to the Pacific division, was transferred to the second division, which had charge of preparing the designs for the shops, dry docks, and coaling stations. The locks, dams, spillway, dry excavation between and below the locks, the quarry, and the municipal engineering work was organized into the fifth division of the chief engineer's office and placed in charge of Mr. H. O. Cole as resident engineer. The dredging and the operations for the procurement of sand were constituted the sixth division of the chief engineer's office, under Mr. W. G. Comber as resident engineer.

The jurisdiction of the quartermaster's department extended from Porto Bello to Balboa, and the timekeeping was centralized in the chief quartermaster's office. To this force was later assigned the timekeeping for the various offices at headquarters. When the first division undertook the installation of the machinery at the locks the timekeeping of this division was also turned over to the timekeeping force of the quartermaster's department. The same was done when the fortifications division was organized, and the results

obtained from this consolidation were so satisfactory as to lead to the conclusion that economy, without any impairment of accuracy, would result by consolidating all the timekeeping under one head. Accordingly this was done gradually under the examiner of accounts, in order that it might be properly started, and when all work of this kind for all the departments and divisions, except the central division, was combined, the timekeeping force was turned over as a part of the organization of the fourth division of the chief engineer's office on July 1, 1913.

For similar reasons the cost keeping that had formerly been done by the various divisions of the work was gradually consolidated under the chief accountant, so that at the close of the year he had charge of all work of this character, with the exception of that of the central and mechanical divisions.

An architectural force was organized under Mr. Austin W. Lord, architect, July 1, 1912, to draw up the plans of the administration building, a general scheme for the establishment of the new town that is to be created at Balboa, near the Pacific entrance of the canal, and to prepare designs for the houses for the permanent operating force.

When it was finally decided to turn the water into Culebra Cut in October, 1913, and to complete the remaining excavation by dredges, all the dredging on the Isthmus was combined under one head, with a view to organizing the work so that the equipment could be used to the best advantage. Effective May 1, 1913, the dredging work under the Atlantic division was transferred to the sixth division of the chief engineer's office, thus consolidating it with the dredging organization of the Pacific side. On this same date the dry-dock shops at Cristobal were transferred to the mechanical division.

Effective May 1, 1913, a change was made in the offices of the examiner of accounts and the disbursing officer by which the system formerly in vogue of separate checking of vouchers and pay rolls in each office was eliminated, thereby conforming to the provisions of the act of August 23, 1912, making appropriations for the legislative, executive, and judicial expenses of the Government. The examiner of accounts is now held responsible for the accuracy of the accounts in all details.

## CONSTRUCTION AND ENGINEERING.

### FIRST DIVISION.

The first division of the chief engineer's office, under Col. H. F. Hodges, United States Army, assistant chief engineer, continued in charge of the design of the locks, dams, regulating works, and acces-

sories; the design and construction of aids to navigation; the inspection of the manufacture and erection, under contract or otherwise, of the lock gates, operating machinery, gates and valves, emergency dams, and chain fenders; and of the placing of such concrete in the locks as was omitted until the installation of the machinery.

The designing work for the locks, including all detail drawings needed by the working force in the field, as well as for the spillways, approach piers, and wing walls, was completed. After performing some work for the second division on the coaling plants and canal terminals, the force in charge of these designs was disbanded on June 1, 1913.

The complete installation for a set of rising stem valves requires setting the valves, placing the stems, roller trains, crossheads, motors, and control panels. It developed that the fixed ironwork for guiding the valves and for forming the water seals required correction before installation could be begun. For all the valves at Gatun and all but two at Pedro Miguel the corrections were made by chipping and grinding with pneumatic hand tools; for the two at Pedro Miguel and all the valves at Miraflores it was done by a specially designed milling machine. Ninety-four per cent of the fixed irons had been corrected at the close of the year. During the year 102 rising stem valve chambers were prepared, including 50 at Gatun, 28 at Pedro Miguel, and 24 at Miraflores, and 104 valves, including trains and sealing devices, were placed in position in the locks. Of this latter number, 48 were at Gatun, 28 at Pedro Miguel, and 28 at Miraflores.

Tests were made, with satisfactory results, on 39 rising stem gate-valve machines at Gatun, 20 at Pedro Miguel, and 8 at Miraflores. All machines were given a preliminary and an acceptance test, the latter consisting of 10 cycles made at five-minute intervals. The thrust screws must run silently; the temperature of the crosshead nuts must not exceed 50° C., and no heavy vibration is permissible.

Six side-wall intake screens were placed at Gatun and the bulkheads to the center-wall intakes were removed and placed in the outlet. At Gatun the four lower side-wall bulkhead gates were also placed.

Guard valves were provided as duplicates to the upper rising stem valves in emergency, or for use in closing the intakes in the side-wall culverts for unwatering the culverts to permit access to other valves for painting and repairs. The design of the machinery for these valves was completed in August, 1912. The design was determined by the cramped position in which the machines had to be placed; because of the infrequency of operation, as well as their slow speed, it is simpler and cheaper than for the rising stem valve. On November 14, 1912, a contract was awarded for 18 complete machines,

excepting the motors, limit switch, counterweight bases, and counter weights, and 50 per cent of the machines were delivered before the close of the year.

The last of the cylindrical valve machines purchased under contract was delivered January 15, 1913. The mechanical installation of the 120 cylindrical valves was completed June 1, 1913, and the electrical work of installing control panels and cables with necessary conduits for these machines was 41.6 per cent complete for all locks. As the result of tests made to determine the leakage of the cylindrical valves, it was decided to regrind all valves so as to allow a maximum average opening around the seat of 0.004 of an inch. The operating machinery is the same for both cylindrical valve and auxiliary culvert valve machines, except that 60-inch and 36-inch strokes are required for the 60-inch and 36-inch auxiliary culvert valves, respectively, instead of the 32-inch stroke of the cylindrical valve. Tests were made to determine the time required to open the various types of valves, with the result that the cylindrical valves required 10 seconds, the 60-inch auxiliary culvert valve 16 seconds, and the 36-inch auxiliary valve 10 seconds.

Tests of discharge were made on the cylindrical valve and the three rising stem gate valves in the spillway. The first series of observations, with heads varying from 8.94 to 29 feet above the center of the valve, gave values of the coefficient of discharge for the cylindrical valve of 0.445 as the mean of three observations, and for the gate valves of 0.592 as the mean of six observations. These observations were complicated by the screens at the culvert entrances, which became clogged with dirt and debris. After the screens had been removed a considerably increased coefficient of discharge resulted for the rising stem valves; the average of 58 observations, with an average head of 29.81 feet above the middle point of the valve, gave a value of the coefficient of 0.68. It is probable that a less favorable value will be obtained in operating the lock culverts on account of the friction and changes of direction in the stream after it passes the valve. The cylindrical valve was removed before the later and more reliable observations were made.

During the year, 14 gates and 1 caisson for the spillway at Gatun and 8 gates and 1 caisson for the spillway at Miraflores were erected complete, under contract, and the contract closed. The gates at Gatun were installed in position on the dam. The Miraflores spillway was under construction and not ready for them. The draft tubes for the hydroelectric station, which are placed on the east side of the spillway dam at Gatun, were completed.

All the spillway gate machines and pumps for unwatering the counterweight pits, purchased under contract, were delivered during the year and a satisfactory test was made of the first machine erected.

The device for shifting the gate upstream a slight distance after it is clear of the water and the mechanism for raising the roller train out of the water after the pressure on the gate is relieved operated properly. At the close of the year the mechanical work had been started on 12 of the 14 machines at Gatun and 71 per cent of the mechanical work on all machines was completed.

The construction and erection of the lock gates was continued during the year under contract with the McClintic-Marshall Construction Co. dated June 21, 1910. All shop drawings were completed, as was the manufacture of all material for the gates, aggregating 57,500 tons; the final shipment was made in April. In addition, about 2,100 tons of structural work for spare parts were built and delivered on the Isthmus, completing this part of the contract with the exception of a few castings, bolts, and rivets. The spare parts comprise sufficient material for partly or completely rebuilding any two-gate leaves on the canal in case of accidental injury. The work of erecting the lock gates proper began at Gatun May 17, 1911, at Pedro Miguel August 7, 1911, and the first work at Miraflores was done on September 10, 1912. At the beginning of the fiscal year work was in progress on half the total number in all the locks, but none of them had been entirely completed. The total amount of steel assembled was only 19,361 tons or about 34 per cent of the total, and much of this was only partly reamed and riveted. The total number of field rivets was about 963,000, or about 18 per cent of a total of over 5,700,000. The work had been allowed to drag so that the task of completing it within a reasonable time seemed hopeless. The contractors decided upon a change in their local management and, beginning about September 1, installed much additional machinery, largely increased their force, and arranged for more efficient supervision. Within a few months the improvements in the organization became manifest; a high degree of efficiency was reached, with a correspondingly large increase in the work done. Some idea of the improvement may be judged from the fact that during the month of March a maximum of 660,000 rivets were driven, while the highest number driven in any one month prior to September 1, 1912, was 213,000. On June 30, 1913, over 97 per cent of all material was assembled in the gates. All the leaves in the west chamber at Gatun and in the east chamber at Pedro Miguel had been stepped on their pintles, and all the leaves in the west chamber at Miraflores, excepting the two leaves of the operating gate in the lower chamber. All the guard gates were complete except those at the lower end of Miraflores locks, and the guard gates at both ends of the Gatun locks had been permanently closed at the end of the fiscal year. Those at the upper end were put in service about July 20, 1912, and the lower guard gates were closed June 11,

1913; the latter sustain the maximum working head of about 40 feet without appreciable leakage.

A supplemental contract was entered into with the contractors under date of January 14, 1913, by which certain restrictions governing payments were modified, as the original provisions proved to be unnecessarily severe and it was clear that a more speedy completion would be assured by relaxing. The modification provides for successive partial payments on each gate when the assembling, riveting, finishing, and painting have been completed and accepted. A further supplemental agreement was signed May 20, 1913, which gave an extension of time for completing the gates. A number of delays occurred for which, according to the terms of the contract, the contractors could not be held responsible. These were in part due to shipwrecks and strikes, as well as delays caused by the commission. The rate under which the liquidated damages are to be computed was increased, while, on the other hand, new and later dates were fixed for the completion of the several gates. June 1, 1913, was the date fixed for the upper guard gates at Pedro Miguel, and June 15 for the guard gates at the lower approaches to Gatun and Pedro Miguel and the upper approach to Miraflores Locks. The lower guard gates at Miraflores are to be finished by September 1, 1913, and all the other gates necessary to permit the lockage of vessels through one side of each flight, from ocean to ocean, must be completed not later than October 1, 1913, while the date of final completion for all the remaining gates is fixed at January 1, 1914, for Gatun and Pedro Miguel, and March 1, 1914, for Miraflores. From the progress being made by the contractors these dates will be anticipated unless some unforeseen contingency should arise. The total weight of all gates on the canal, excluding pumps, floats and float switches, motors and conduits, and other electrical apparatus, the castings for attaching the operating struts, and the miter forcing machines, is 57,552 tons. The castings and structural parts to be embedded in the masonry were in part furnished under the contract for the lock gates and were erected by the commission in connection with the concrete construction. The total amount thus far expended is \$4,820,019.32, of which \$4,065,392.01 was paid under the contract, and the balance of \$754,627.31 was for inspection and division charges.

The entire shipment of miter gate-moving machines was completed during May, 1913, but the work has been handicapped by the non-receipt of parts that it is necessary to embed in the concrete and about which the erection of the whole machine hinges. At the end of the fiscal year 86 per cent of all machines had been installed. The electrical work in connection with these machines was 24.2 per cent completed at the close of the year.

The miter gate-moving machines had been installed complete on the upper guard gates at Gatun, and a test was made of this machinery on July 31, 1912. The gate-moving machine was adjusted so that when the strut arm was at dead center on the crank gear the gates were closed with a compression of the strut for one leaf of five-thirty-seconds inch and for the other leaf of nine-thirty-seconds inch. The limit switches were adjusted so that the gate traveled from its full miter position to the opposite position in the recess, at which point the machine was again on dead center. The gates were started from a miter position and opened to their full position in the recess and again closed. The time of operation of one leaf was 1 minute and 51 seconds and for the other 1 minute and 50½ seconds. The operation was completed a second time. During both operations the mitering of the leaves was perfect. The gates also had installed a miter-forcing machine which had been purchased under contract, and this was tested out on the same date, under approximately actual operating conditions. One leaf was left in its closed position and the other opened a distance of 2 inches. The miter-forcing machine was then operated and it brought the gate to within three-fourths inch of perfect miter. Another trial, with an opening of 3½ inches, brought the gate to a point five-eighths inch from miter. During these tests the miter-forcing machine was operating against the resistance imposed by the strut. As the result of the test several changes were made and the option under the contract of purchasing the remainder of the miter-forcing machines required for all the locks was allowed to lapse and new proposals invited. Under the new contract all the machines required have been delivered. The work of installation, however, was delayed on account of noncompletion of the work on the structural gate parts.

An account of the studies made to determine the most desirable type of chain fender, together with a description of the design selected for the construction of a trial unit, was given in the annual report for 1911. Under the contract entered into on November 4, 1911, all material for the trial fender was delivered on the Isthmus by December, 1912. The erection was begun about January 1 and practically completed by March 1, 1913. During the months of March and April a number of tests were made. The first series consisted of raising and lowering the chain by operating the centrifugal pumps, and the general operation of the machine, including the action of the moving cylinders, girders, and the passing of the chain over the sheaves, was satisfactory from the beginning. The pumps and their motors were of sufficient capacity to raise and lower the chain in the specified time—one minute. The chain dropped uniformly from both lock walls and, in its final position, rested at the bottom for the full width of the lock chamber, with its vertical parts

entirely within the chases in the walls. A second series of experiments was made by use of a Lidgerwood unloader to test the operation of the fender under conditions somewhat similar to those that will prevail when the chain is struck by a moving vessel. Under such circumstances the chain will gradually pay out, touching the curved surface of the hawsepipe castings in the walls, over a constantly increasing arc of contact. The movement will be resisted in part by the friction of the chain along the hawsepipes, in part by the internal friction of the machinery, but mainly by the hydrostatic pressure which acts against the upper surface of the moving cylinder. In the final tests made the maximum pressure reached 630 pounds per square inch, when the chain parted near or on one of the lower sheaves. This pressure corresponded to a stress on the chain of less than one-half the breaking strength obtained in the shop tests. The results obtained seem to warrant the belief that a vessel, unless of very great size or moving at excessive speed, can be checked or stopped without breaking the chain, provided the latter is structurally sound. The great tidal range below Miraflores locks made a modified design necessary. The same system of cylinders is used and the machinery in all its parts is practically the same, but the chain is stretched across the lock at either of two levels, according to the stage of the tide. The chain is endless and, by a stop mechanism, may be operated electrically from the central control house. The chain that passes through either hawsepipe is connected with the operating machinery and is raised or lowered, that which passes through the other hawsepipe remaining at rest.

Plans and specifications for the floating caissons, referred to in previous annual reports, were completed and invitation for proposals issued on May 23, 1913. The caissons will be used for closing the upper and lower entrances to the lock chambers when unwatering them, and will contain a pumping plant of sufficient capacity for pumping out the locks. They are ship caissons, with vertical ends and curved surfaces throughout. Their extreme length is 113 feet 10 inches, molded breadth 36 feet, breadth of the top deck 18 feet, and depth at the side 65 feet. With fixed ballast only, the caissons will float at a draft of 32 feet, which will be increased to a maximum of 61 feet by flooding them when they are put in place on the deepest sills. Trimming tanks are provided to keep the caissons on even keel. The pumping system will include 4 centrifugal pumps of the volute type with a 20-inch discharge, besides a small auxiliary pump. The capacity of each of the large pumps is specified at 13,000 gallons per minute, which will insure the unwatering of any of the locks within 25 hours. The flooding of the caissons will be done by gravity and two of the four large pumps are arranged for pumping them out.



The pumps and ventilating fan will be electrically driven, while the cranes and windlasses will be operated by hand.

All the remaining parts of the towing track material to be furnished under contract were delivered on the Isthmus before the close of the year. The total amount delivered aggregated approximately 53,950 linear feet and at the close of the year 36,908 linear feet had been installed complete with concrete, and 11,168 linear feet had been distributed and bolted up ready to be aligned and concreted. The installation of most of the return track has been performed by the Atlantic and Pacific divisions during their construction work.

Bids were invited for towing locomotives on design prepared by the electrical subdivision, and a contract was entered into for furnishing 1 locomotive with the option of purchasing 39 more, or of substituting for this locomotive one built according to the design submitted by the successful bidder. The locomotive was delivered on the Isthmus January 25, 1913, and ready for operation February 7, after which it was tested. The result of the test developed defects, so that changes and improvements were necessary in order to fulfill the conditions required. While the contract provided for making minor changes if found necessary, the changes and improvements which it was decided should be made in order to make the machine satisfactory could not be classed as minor ones. As a result, advantage was taken of the option in the contract and an order was placed for the required number of locomotives on the design submitted by the General Electric Co., abandoning the design of the commission.

A series of tests was made in Limon Bay on ships of the Panama Railroad fleet, at various speeds and rates of acceleration, to serve as a check on the basis used for the design of the towing locomotives. The size of the ships ranged from 3,500 tons to 10,400 tons displacement at actual draft at the time of the tests. A tug was used which could exert a maximum pull at standstill of about 15,000 pounds. A manila towrope of 7-inch girth indicated a pull on a dynamometer consisting of spiral springs working between circular end plates with a steel scale for indicating the compression of the springs. The start was made from rest, in position alongside the dock, and the ship accelerated to the desired speed as quickly as the power of the tug permitted. The speed was then held constant until a sufficient number of readings had been obtained to insure representative results. Readings were taken of dynamometer pull, tug speed, angle of tow line with center line of tug, angle of tow line with ship, and ship's bearings, at intervals of 30 seconds throughout the run.

The total amount of insulated cable on order to date for all classes of work on locks and hydroelectric station, including the underground lines from the hydroelectric station to the locks, aggregates 2,372,110 feet, of which 1,394,600 feet are lead-sheathed cable and the

remainder, 977,510 feet, rubber-covered double-braided wire and cable. About 93 per cent of the total amount required has been delivered complete. A total of 462,729 feet of lead-sheathed cable has been pulled into the ducts, and a large part of the remaining ducts has been rodded and cleaned and is wired with fish wires for pulling in the remainder of the cable as needed. All cable is pulled in ducts by a special winch made on the Isthmus and driven by a small motor. The cable is greased and pulled through the ducts at the rate of 70 feet per minute. A few lengths as long as 900 feet, where duct conditions were favorable, were pulled without undue strain on the cable or appreciable abrasion of the lead sheath. A large number of observations were taken to determine the amount of pull for various lengths and combinations of different cables.

During the year the control scheme for the various locks was completed and contemplates the control of every piece of machinery in the lock walls from a central station, situated on the center wall of the upper locks, where an uninterrupted view of the entire lock or flight of locks may be had. In this house is located a control switchboard connected with every local control panel and indicating mechanism. The switchboard is so arranged that the indicator and control switch of each gate or valve machine is placed in the same relative position to other indicators and control switches as that occupied by the actual machines, so that by means of red and green lights and small models of gates and valves operated by synchronous transmitting mechanisms the operator in the control tower is able to tell at a glance the condition in any part of the locks from the switchboard indications. It is expected that the first board will be shipped by August 1.

The general features of the illumination of the locks were described in the last annual report. A hollow concrete pole with concrete bracket arms and reflectors was designed by the architect for supporting the lamps for exterior illumination of the locks and grounds. The center-wall poles carry a single bracket and lamp projecting toward the chamber, and the side-wall poles carry double bracket lamps, so as to give a broad illumination over the lock chambers and the ground surrounding the locks. The poles are arranged in 4 rows along the whole length of the locks, 1 row on each side wall and 2 on the center wall. They are spaced approximately 100 feet apart, with the lamps 30 feet above the coping level. The lighting units used are 110-volt, 500-watt Mazda lamps.

The generating equipment for the hydroelectric plant was delivered during the year, including the main generators and turbines, with exciter sets, traveling crane, penstocks, head gates, and operating machinery. The steelwork for the hydroelectric station was purchased under contract, and the delivery was completed before

the end of the year. The erection of the penstocks is complete and all turbines have been set. The balance of the work of installation is dependent upon the completion of the building for housing the electrical equipment.

During the year it was decided to install for the transmission line an overhead system of 44,000 volts, extending from Balboa to Cristobal, and connecting the Gatun hydroelectric power station with the present Miraflores steam power station, so that they may be operated separately or in parallel, as necessary. Four substations are provided, and located at Cristobal, Gatun, Miraflores, and Balboa. The complete line consists of duplicate three-phase lines, one of which is carried on each side of track-span bridges spaced 300 feet apart on tangents and 200 feet on curves along the whole length of the Panama Railroad. The bridges are of structural steel, with a clear track span of 36 feet, and an over-all height of 40 feet. The conductors are to be 2/0 stranded copper wire spaced with a clearance of 5 feet. They are supported from brackets outside of towers, with three-part suspension insulators, with noncorroding connecting links to allow a maximum life and a minimum of line troubles.

During the year the remaining shop drawings for the emergency dams were completed and approved. Full-sized tests were made upon the gates prior to shipment, as required under the specifications, the object being to insure that the friction upon the rails will not be so great as to prevent the lowering of the gates by their weight alone, and that no objectionable distortions or permanent sets will be produced by the maximum pressure to which the gates will be subjected. Practically all structural material for the turning and wedging machinery for the emergency dams was shipped to the Isthmus and, with a few exceptions, has arrived in excellent condition. The assembling of the east dam at Gatun was begun July 1, 1912, and was practically completed on March 1, 1913. Erection of the west dam was begun on November 9, 1912, and was practically completed in five and a half months, or March 1, 1913. The material for the west dam at Pedro Miguel was received in time to begin erection on February 1, 1913, and practically all of the material has been assembled. Work was begun on April 1, 1913, on the east dam, and by June 30 over 50 per cent of the material had been assembled in the structure and 30 per cent of the riveting had been completed. Delivery of material for the east and west dams at Miraflores began on May 1, 1913, and up to the end of the fiscal year about 840 tons had been received. The erection of the east dam was begun on June 1, 1913, and of the west dam on June 13, 1913. On May 20 the contractor began the final tests of the dam on the east side at Gatun, the total time for closing in the first test being 1 hour 1 minute and

30 seconds. After three complete operations of the dam, as required by the contract, the second part of the test was started, consisting of operating the turning and wedging machinery for 20 days, at intervals depending upon the heating of the motors. These tests were made principally for the purpose of limbering up the turning and wedging machinery. After completing the second part of the tests, three additional complete operations were made in accordance with the contract; the last completely closed the passage in 42 minutes and 17 seconds, which was 19 minutes and 13 seconds less than the time occupied in the first test.

Under the aids to navigation 12 range towers were completed, with some minor exceptions in the Gatun Lake section. These towers are of reenforced concrete, with heights from base to focal plane varying from 28 feet 10 inches to 87 feet 10 inches. Three skeleton tower beacons, marking the edges of the channel between Balboa and Miraflores, were completed. Eighteen concrete-steel reference and range targets were completed in the Gatun Lake section. There will be approximately 32 of this type, by means of which gas buoys may be located from previously determined angles. At Bohio, Pena Blanca, Caimito, Mamei, Juan Grande, and Bas Obispo these reference targets also form unlighted ranges which mark the axes of the short tangents at those places. The reenforced concrete caisson for the west breakwater light and fog signal, which was begun in June of last year, was completed up to a height of 25 feet and was sunk at the inner end of Limon Bay in 20 feet of water, where it will remain until its riprap foundation at the outer end of the breakwater has reached its final settlement. The plans for the west breakwater light and fog signal were revised under the supervision of the architect and the revised structure supersedes the one shown in the last annual report. Fifty-one concrete buoy sinkers 48 by 48 by 26 inches and forty-five 24 by 24 by 18 inches were constructed at the Balboa plant of the lighthouse subdivision. A reenforced concrete wharf 70 feet long and 30 feet wide, adjoining the small boat landing at Gatun, was built for use of the lighting establishment of the canal by the Panama Railroad. It will be used for storing, painting, and repairing gas and spar buoys belonging to the Gatun Lake section. Experiments were made with Tungsten lamps having a spirally wound filament concentrating the light source to spheres of one-half inch for 100-watt and five-eighths inch for 150-watt lamps and, as these proved successful, that type of lamp will be used throughout for all electrically lighted range towers and beacons. Experiments were also made for special flashing devices and lamp shifters for electrically lighted towers and beacons and bids for their manufacture will be asked for in the near future.

Approximately 250 acres of canal prism from San Pablo to Pena Blanca were cleared of trees and brush, and approximately 180 acres of land were cleared of trees in the vicinity of Mamei for the dredging division.

For detailed information concerning the operation of this division, attention is invited to Appendix A.

#### ATLANTIC DIVISION.

The work of this division embraces the construction of the locks and dam at Gatun, the quarry at Porto Bello, the sand supply, the breakwater for the shelter of shipping and protection of the channel at Limon Bay, the municipal improvements in Colon and the various settlements embraced within the territorial limits of the division, and such sanitary engineering work within the same limits as is prescribed by the sanitary department. The work of excavating the channel between the Gatun locks and deep water in the Caribbean was in charge of this division until May 1, 1913, when it was transferred to the sixth division of the chief engineer's office. On this same date the dry dock and shops were transferred to the mechanical division. The work of the division is in charge of Lieut. Col. William L. Sibert, United States Army, as division engineer.

At the beginning of the fiscal year dredges were at work excavating an area north of the caisson sills of the locks, within which the flare or wing walls and the north approach pier were to be constructed. The wing walls are built on rock and the approach pier partly on rock, but for the greater part on piling. For the former it was necessary in some places to remove material to a depth of 70 feet below sea level in order to uncover the rock; and as the dredges could excavate only to a depth of 41 feet, the level of the pool had to be lowered for them to perform the work. To accomplish this a clay dam was built across the cut excavated by the dredges to reach the area, and, when completed, the water in the resulting inclosure was lowered by pumping with the dredges. The excavation for the flare walls was carried well to the rear and made sufficiently wide for the walls and for a rock fill which was to sustain the material back of it from sliding as the water was lowered. This fill also formed a foundation on which to carry the cableway tracks. It was anticipated that by extending the rock fill to the north the cableway tracks could be laid, so that the construction plant could be used to build the entire length of the center approach wall; because of the softness of the material, which, as the water receded, assumed a slope of 1 on 13 in some portions, this plan had to be abandoned.

For the approach pier the dredges removed material to a depth of 55 feet below sea level and for a width of 140 feet along the center of the excavated area. On completion of the dredging in November, 1912, the pit was filled with water, the clay dam removed, a dipper dredge and one suction dredge taken out, and one suction dredge, a pump barge, and two coal barges left inside the area. The clay dam was then rebuilt and water pumped out, exposing the foundations. The dredge was grounded at 55 feet below sea level and was used to keep the water below the foundations. Two steam shovels worked over that portion of the center wall foundations where rock appeared, and also excavated such material from the approach to the west locks as could be handled by them. The channel excavation and the preparation of the foundations were accomplished by shovel, crane, cableways, and by hand.

The flare walls are built solid. The north approach wall or pier is 58 feet wide and consists of a series of piers placed 50 feet centers longitudinally and 40 feet laterally, in which direction they are connected by arches of 22-foot span, while longitudinally they are spanned by steel girders incased in concrete. In plan the piers are therefore 10 feet by 18 feet. The piers rest upon a slab of concrete, heavily reenforced with old rails near the top and bottom, built on the piling. The first six of the openings north of the locks are closed by curtain walls to prevent objectionable cross currents while the locks are emptying. The plan originally contemplated a pier 1,200 feet in length, measured from the angle of the flare walls. In December, 1912, the division engineer recommended that the wall be shortened 200 feet. A slide had occurred at the north end of the pit when it was dewatered, covering the foundation of this portion of the wall, and the removal of this slide, which would have to be done largely by hand, would be tedious and require considerable time; furthermore, this would make the north approach wall correspond more nearly to the one at the south, which is 994.5 feet long. The local conditions where the south wall was terminated were such as to make the cost of building the additional length prohibitive; however, as a considerable saving in time of completion would result, the recommendation was approved and the length of the north approach pier was therefore fixed at 1,000 feet. The foundation for the pier required the driving of 5,000 piles, aggregating 200,549 linear feet, at a cost of \$0.5504 per foot. For the curtain walls 5,657 feet of sheet piling were driven. On January 25, 1913, while this work was in progress, a slide occurred on the east side, which covered a large part of the foundation with from 6 to 18 feet of material, largely mud, destroying two of the pile drivers and delaying the work. The material was partly removed by crane and hand,

but largely by sluicing and pumping, the dredge handling the material from the sump into which it was washed.

The concrete in the flare walls was laid by the cableways, which were also used for so much of the center pier as could be reached by them. The remaining portion of the latter was laid by cranes and by means of dump cars operated by construction locomotives, the concrete being supplied by the cableways through hoppers and chutes. The total amount of concrete laid in the locks proper aggregated 164,750 cubic yards; of this amount 137,218 cubic yards were classed as plain concrete, and cost \$6.5383 per cubic yard; the balance was reenforced, and cost \$10.5762 per cubic yard. In addition, 5,530 cubic yards of concrete were used for the construction of lamp-posts and their bases, snubbing-button bases, machinery-room covers, control house, paving between the upper lock and the Panama Railroad station, under the emergency dams, and for the work of the first division, making the total handled by the Atlantic division 170,280 cubic yards. The total amount of concrete laid in the locks by the Atlantic division up to the close of the fiscal year therefore aggregated 2,040,715 cubic yards, at an average division cost of \$7.1220 per cubic yard.

Last fall it was estimated that the concrete work of the locks would be completed by July 1, 1913. By shortening the north approach pier 200 feet, all the concrete, except miscellaneous finishing, was completed on June 14, 1913. The miscellaneous work consists of lamp-post bases, snubbing-button bases, mooring-post bases, stairwell parapets, paving, and the closing of a few openings which were left for construction purposes. Of the amount of concrete laid during the year, 2,742 cubic yards were produced by auxiliary mixers, 1,944 cubic yards were mixed by hand, and the balance by the 2-yard mixers installed in the construction plant.

In addition to handling sand from the barges to the stock pile, the unloading cableways were used for transferring sand and rock from the stock piles to the tunnel hoppers and for loading rock for sale to outside parties. There was sufficient broken stone in storage so that none was crushed during the year. A total of 171,866 cubic yards was taken from the storage pile for use by the division, 1,568.5 cubic yards for issue to other divisions and sale to outside parties. To the storage pile on hand at the beginning of the year 43,851 cubic yards of sand were added, secured from the Chagres River by means of a suction dredge. This sand cost \$0.5188 per cubic yard delivered in stock. Cement delivered in bags, amounting to 225,000 barrels, was received and handled, partly by barges from the ship and crane into the cement shed, and partly by car transfer, then by hand into the shed. Of the amount on hand, 227,000 barrels were issued for use.

The back filling of the side walls and the filling of the center wall was made of material obtained from borrow pits and from the canal prism, aggregating 637,226 cubic yards, all of it removed by steam shovels. Of this amount, 565,756 cubic yards were placed behind the side walls at a cost of \$0.3805 per cubic yard, and 15,872 cubic yards in the center wall by the cableways at a cost of \$0.8320 per cubic yard. The total amount of material used for back fill up to June 30, 1913, aggregated 2,027,830 cubic yards placed behind the side walls at an average cost of \$0.4586 per cubic yard, and a total of 113,163 cubic yards placed in the center wall at a cost of \$0.7780 per cubic yard. Teams and scrapers were put to work in March, 1913, and continued to the end of the fiscal year bringing the back fill to final grade and for the construction of a wagon road along the east side of the locks. About 1,500 cubic yards of material were handled in this way, at a total expenditure for this purpose of \$9,296.82. It was decided to pave the exposed surface of the back fill between the locks and the Panama Railroad station with concrete slabs 5 feet by 5 feet by 6 inches, extending from elevation 78 to the top of the slope, and laid on from 4 to 6 inches of broken stone from Ancon quarry. Below this concrete paving the slope was to be covered with riprap stone down to elevation 74. The concrete paving was estimated to cost \$8,000. On June 30, 1913, the surfacing of broken stone was completed and 125 square yards of the concrete paving had been finished at a total cost for the latter to that date of \$1,172.91.

The lamp-posts and bases for illuminating the locks were constructed by this division, the bases erected in place, and the lamp standards cast; of the latter, 211 were made at a cost of \$149.4299 per lamp-post.

The construction of the control house, designed by the first division, in conjunction with the architect, for the Gatun locks was begun in April, 1913. At the close of the year the three floors and the walls for the first and second stories of the building were completed; the total amount expended was \$20,287.51.

At the close of the previous fiscal year the Gatun Dam had been raised to an elevation of 103.35 feet for a length of 1,000 feet east of the spillway, and for the balance of this portion of the dam the dry fills had reached a general elevation of 96 feet and the hydraulic fill between them a general elevation of 85 feet. On the portion of the dam west of the spillway the north and south fills had reached a general elevation of 98 feet and the hydraulic fill an elevation of 87 feet at the spillway and 78 feet at the drains located in the northwest corner of the dam.

At the close of the fiscal year just ended sufficient material had been added to raise the dam to practically its full height, with 3 to 5 feet additional along the axis to allow for settlement. The dry



fill was secured from the borrow pit which had been opened during the previous fiscal year, beyond the west end of the dam, and the clay used to top off the hydraulic fill from borrow pits north of the dam and in the vicinity of the locks. From two to six steam shovels were engaged in procuring this material and removed 2,159,159 cubic yards, borrow-pit measurement, of which 922,877 cubic yards were designated as rock. The hydraulic fill was supplied by three pipeline suction dredges operated in borrow pits upwards  $1\frac{1}{2}$  miles distant, the maximum lift being 100 feet. The total amount handled, borrow-pit measurement, was 493,145 cubic yards. The hydraulic fill was stopped in September, 1912. No complete survey was made during the fiscal year, but partial cross sections were run monthly until February, 1913, from which the material in place was calculated, and for the following months, estimates were based on borrow-pit measurement. Under these circumstances it is estimated that the dry fill deposited aggregated 1,714,367 cubic yards, or a loss of 21 per cent of the borrow-pit measurement, due to consolidation. Of the hydraulic fill, it was estimated that there was a loss of 324,141 cubic yards or 65.8 per cent due to waste through drain pipes, leakage, and consolidation. The total consolidated fill for the year aggregated 1,967,841 cubic yards. The cost of the dry fill in place amounted to \$0.3755 per cubic yard and of the hydraulic fill \$0.2654 per cubic yard. Levels were run monthly with a view to determining settlement, observations being taken on hubs placed about 250 feet apart longitudinally and about 100 feet apart transversely.

On the morning of August 29 a bulging and sliding movement began along the north slope of the dam near the west end. At 7 o'clock in the morning of this date the track which was at the top of the dry fill, elevation 101, settled vertically about 3 feet over a length of about 200 feet, while the track at elevation 63, down the slope, showed slight indications of movement. In the afternoon of the same day a lateral displacement of 8.8 feet had occurred on the 85-foot contour and 5.1 feet on the 50-foot contour; there was no movement on the 30-foot contour. On the morning of August 30 a further settlement and bulging had occurred, giving an additional lateral movement of 3.4 feet on the 85-foot contour, 3.2 feet on the 50-foot contour, while the toe of the slope still remained undisturbed. By the morning of August 31 a still greater displacement had occurred, adding 8.6 feet to the lateral movement on the 85-foot contour, 9 feet on the 50-foot contour, while the foot of the slope was pushed out laterally 6.2 feet on the 30-foot contour. The movement continued through September 1 and ceased September 2. The maximum vertical settlement of the track at elevation 101 was 20 feet, extending for a distance of 750 feet along the crest, affecting not only the hydraulic fill but the north slope of the dry fill to the south of it.

The total lateral displacement along the 85-foot contour was 33.9 feet, on the 50-foot level 31.2 feet, and on the 30-foot contour 18.1 feet. The south slope of the dam remained undisturbed. The slope of the portion of the dam which moved was originally fixed at 1 on 5 (section DD, plate 19, annual report, 1909), and this was authorized "because the rock is near the surface and fairly horizontal. The only thing to be provided against in this slope is the slipping of the dam material on itself." Because of the character of the material along this portion underlying the structure there could be no question that the movement was within the dam itself, consequently test pits were not resorted to as in the case of the movement on the east part of the dam, reported a year ago. A line of wash borings with drive samples was made. These borings clearly indicated that the relative proportions of hydraulic fill and dry fill which would bring about the desired section of hydraulic fill—wedge shape, with the point down—had not been secured, but that on the contrary the hydraulic fill in section was the opposite of this. Furthermore, it was evident that provision had not been made against the slipping of the dam material on itself. As in the case of the movement on the north face of the east portion of the dam, the toe was heavily reenforced and the slope flattened to an average of about 1 on 7.67.

To prevent injury to the dam that might result from wash of the south slope by waves in the lake caused by strong south winds, which prevail at times, it was necessary to pave such portion of this slope as is liable to such action. Concrete paving was at first considered, but because of settlement, due to consolidation and the irregularity of the surface, it was decided to use riprap laid on broken stone. It was estimated that waves 5 feet in height might at times exist, so that the paving was extended over that portion of the slope lying between elevations 74 and 92. A layer of crushed stone, supplied by Ancon quarry, was laid over the dam within these limits to a thickness of about 4 inches. Over this a sufficient thickness of riprap was placed to protect the broken stone from the action of the waves. The riprap was at first procured from a quarry in the vicinity of Quebrancha and was estimated to cost \$1 per cubic yard in place on the dam. As the cost, however, after a trial of two months, amounted to \$2.1027 per cubic yard in place, and as the stone was mixed with a considerable amount of clay, this quarry was abandoned and the stone was furnished from the excavation for the dry dock at Sosa Hill. An area of 115,740 square yards was covered with crushed stone, of which 15,740 cubic yards were used, completing this portion of the work in April at a cost of \$2.4536 per cubic yard in place. The riprap stone placed at the close of the fiscal year aggregated 68,730 cubic yards, covering an area of 102,030 square yards, at a cost in place of \$0.6574 per cubic yard.

At the beginning of the fiscal year the spillway dam had been completed, including the abutments, ogee, and crest piers, to elevation 69, while the central portion, about 370 feet in length measured along the crest, had been practically completed to elevation 50. As previously noted, four sluices had been left—three closed by Stoney gates and one by a cylindrical valve—to permit control of the water during the construction of the dam. During the fiscal year the flanks were carried to completion, while the central portion, which had been finished to elevation 50, was left at this height to allow the flood waters to escape during the rainy season. Work on the closing of these openings was commenced as soon as the level of the lake could be dropped below elevation 50 and the work pushed. A trestle was erected on the flanks at elevation 95 and was extended entirely around the dam when the full height of 69 feet was reached. From it the west abutment and part of the crest piers were built to elevation 115, or full height, and the 14 crest gates were installed. On the completion of the west abutment the trestle beside each gate was dismantled in succession and the upstream side of the pier, interfered with by the trestle, was constructed. In February the sluice operated by the cylindrical valve was closed, but it was impracticable to complete the remaining crest piers and east abutment until the three remaining sluices could be closed. The water in the lake, controlled by the sluices, was held at about elevation 32 until the last week in August, when the completion of the guard gates and caisson sills of the locks permitted it to be raised. During November and the early part of December the water reached a maximum elevation of 56.3, notwithstanding the flow through the opening left in the central part of the dam and through the sluices. After the rainy season the water was lowered to elevation 48 so that work might be resumed on the spillway, and the sluices were finally closed on June 27, as the plans contemplated raising the lake to full height during the present rainy season, starting with the water at Gatun at elevation 50 on July 1, 1913. The elevation of the lake at Gatun on this date was 49.15. Advantage was taken of the flow over the spillway to dispose of a number of floating islands, snags, and old timbers which the rising waters had brought into existence and which the wind and current had brought down to the locks and dam. The anchorage basin to the east of the channel and the channel itself for a distance of about 6 miles south of Gatun were cleared. These obstructions in the channel were in places 14 feet thick and consisted of matted snags, sticks, and roots of living vegetation that had apparently floated upward from the floor of the swamp below. Such aggregations were broken into small sections by a floating pile driver.

Concrete laid in the spillway for the year aggregated 21,719 cubic yards, at a cost of \$8.1227 per cubic yard. The excavation amounted to 175 cubic yards and cost \$2.3913 per cubic yard. The total amount of concrete thus far placed in the spillway was, therefore, 224,132 cubic yards, at an average cost of \$7.4838 per cubic yard.

Architectural features were added to the plans prepared by the first division of the chief engineer's office for the hydroelectric power plant to be constructed below the spillway at an estimated cost of \$147,950 and its construction undertaken by the Atlantic division. The excavation was completed and during the year 14,948 cubic yards of material were removed—rock and earth—at a cost of \$0.4022 per cubic yard; in the preparation of the foundations 11,684 cubic yards, costing \$1.7973 per cubic yard, were removed; the total excavation to date, therefore, including the preparation of foundations, was 98,751 cubic yards, at an average cost of \$0.5486 per cubic yard. The steel work for the structure was advertised, and the lowest bid amounted to \$25,456.37. The successful bidder offered to erect the steel structure in 45 days and at an additional cost of \$6,496.74. As the Atlantic division estimated that the erection could be done in 42 days by its own forces and completed at a cost of \$4,643, this work was assigned to the Atlantic division. The erection of the steel work was commenced on May 16, and at the close of the year about 65 per cent had been erected and 90 per cent of the field rivets driven. The amount thus far expended was \$6,154.36. The penstocks were encased with concrete, except for the curved portions near the head gates. The forebay walls with trash-rack and stop-plank grooves are about 95 per cent completed.

Work on the west breakwater for Limon Bay was continued throughout the year. A length of 599 feet of trestle, single track, was added, making the total length of trestle 11,526 feet. The total amount of rock received from Porto Bello and placed on the breakwater was 183,762 cubic yards, of which 102,508 cubic yards were handled from barges to Lidgerwood cars by locomotive cranes and subsequently plowed off. The balance was placed by derrick barges. In addition to this source of supply about 220,433 cubic yards of rock removed from the channel by the dredges were dumped on the breakwater. A small pile wharf was built for handling rock by cranes to cars, and 3,000 cubic yards of sand were dredged by derrick barge for the barge berth. The cost of Porto Bello rock placed on the breakwater averaged \$4.8250 per cubic yard.

The quarry at Porto Bello was worked during the year for supplying the large rock required for the breakwater. It was intended to develop the quarry in two benches, each with a height of at least 60 feet at the highest point and approximately 1,700 feet long. Because of the peculiar formation of the hill it was found that suffi-

cient large rock could not be secured from the two benches to complete the breakwater, so that this development was temporarily suspended, and in November, 1912, operations were resumed by one steam shovel in the old crushed-rock quarry, above the two benches; after the first of the year two more shovels were put to work on this higher level. The broad-gauge equipment, which was substituted for the narrow gauge previously in service, was placed in operation on October 5, 1912, and in October the output was increased from two to three barges per day. In securing rock of proper size about 60 per cent of the output was wasted.

As previously noted, the Toro Point breakwater is intended for the protection of the harbor and the shelter of vessels against northers, and its line of direction is normal to the prevailing wind during these storms. It is not intended to give protection against the waves produced by the trade winds, which generally are from north to northeast and which are not dangerous to shipping that will use the canal. The waves from the trade winds have been washing the shores of Limon Bay in the vicinity of the canal entrance, and survey made in March, 1913, showed that the channel in the vicinity of the shore line, which had been dredged to full depth, had filled so as to give an available depth of only 27 feet and that in the center of the channel. It was also estimated that the silt deposited in the channel during the previous 12 months was 2,213,082 cubic yards. As the result of investigation it is believed that this silting is largely due to wave action disturbing the soft material of the bottom of the bay, which is taken up and carried in suspension and subsequently deposited in the deeper channel. The deposit is generally uniform except in that part near the shores of the bay. The Atlantic Fleet during its visit to the canal last winter anchored under the lee of the west breakwater, and at times the trade winds made it difficult for small boats to reach the ships, and, as a consequence, the General Board of the Navy advocated the construction of a detached breakwater for the protection of the anchorage area, stating that at times it would be dangerous and, at times, impossible for small boats and barges engaged in coaling battleships to lie alongside. Under these circumstances, and as such a breakwater will protect the channel to some extent against the wave action causing the silting, by breaking up the waves, the construction of a detached breakwater on the east side is contemplated. Investigations were undertaken in an endeavor to find a quarry more accessible than Porto Bello. To still further protect the channel against material washed from the shores of the bay experimental stone dikes are to be constructed.

As previously reported, the existing water supply for Colon was not adequate and plans were submitted for the construction of a modern filtration plant and pumping station to take the place of the present

plant. This project was approved on July 12, 1912, at a total cost of \$193,768. It contemplates a tunnel through the divide separating the Gatun Lake from the Brazos Brook Reservoir within which is to be laid a 20-inch main, with its inlet at an elevation of approximately 5 feet below the extreme low water level in Gatun Lake. This pipeline, 600 feet in length, extends to the Brazos Brook Reservoir, and by means of a control house the water in the reservoir is maintained at a minimum low level of 1 foot below the spillway crest, so that any additional amount of water required over that furnished by the watershed will be taken from Gatun Lake. An additional 20-inch main was laid from Brazos Brook Reservoir to Mount Hope, the site of the new purification plant and pumping station. In connection with these there are included an aeration basin, sedimentation basin, and filters after passing which the water enters a clear-water basin having a capacity of approximately 650,000 gallons. This basin is connected by an underground conduit to the pump sump beneath the floor of the pumping station. The pumps will be operated electrically. Work was commenced in October, 1912, and at the close of the fiscal year all work between Gatun Lake and Brazos Brook Reservoir was practically complete. The pumping station was completed ready for the installation of the machinery; the filter building was completed up to and including the operating floor; the sedimentation basin was 75 per cent completed; and the foundations and floors of the mixing chambers and aeration basin were laid. In addition to the operation of the purification plant at the Agua Clara Reservoir, the usual maintenance work was carried on during the year.

Approximately 70,000 square yards of macadam were laid and repaired, 44,000 linear feet of road ditches cleaned and dug, 9,500 linear feet of curb and gutter laid, and 4,600 feet of sewers installed. In addition, municipal improvements were carried on in Colon under an appropriation by Congress for the purpose. Of the appropriation of \$800,000 made by the act of March 4, 1909, for extending the municipal improvements in Colon and Panama, there were expended during the year in the former locality \$53,939.15, making a total expended in Colon to the end of the fiscal year of \$505,909.54. In addition to completing improvements previously undertaken, the money was expended in replacing curbs and gutters which had settled, resurfacing, and in extending the improvements to include G Street between Second and Ninth Streets, and in the extension of E Street to its intersection with the Mount Hope Road.

Sanitary work consisted of cleaning and grading 237,000 linear feet of ditches; constructing approximately 53,000 linear feet of ditches, and lining with concrete approximately 26,000 linear feet of ditches. In addition, approximately 6,800 linear feet of pipe and tile drains were laid and cleaned.

For further details, attention is invited to Appendix B.

## CENTRAL DIVISION.

The work of this division embraces the excavation between the Gatun Dam and Pedro Miguel Locks, including diversion channels, the construction of the Naos Island Breakwater, municipal improvements in the various settlements included within the division limits, and such sanitary engineering work in the same area as is prescribed by the sanitary department. The work is in charge of Lieut. Col. D. D. Gaillard, United States Army, as division engineer.

Excavation for the canal prism during the year was confined to Culebra Cut, and 12,582,124 cubic yards were removed. In addition to this, 155,376 cubic yards were excavated in changing portions of the Obispo diversion and 35,888 cubic yards outside of the canal prism for auxiliary work; the total amount of material handled by the central division, therefore, aggregated 12,773,388 cubic yards, of which 10,098,099 cubic yards were classed as rock. The estimated amount removed because of slides was 5,899,200 cubic yards and of this amount 1,593,070 cubic yards of material were taken from the upper reaches of the banks to reduce the quantity to be taken from the bottom, or as a preventive measure against slides and breaks. In other words, 46.67 per cent removed from the Cut was due to slides, as against 35.90 per cent during the previous fiscal year. The amount remaining to be removed was again increased at the close of the year, and aggregates for the Culebra Cut 8,200,000 cubic yards; in other words, there will be an increase for the central division of 9,280,237 cubic yards over the estimate submitted in the last annual report. Of this total remaining, 1,324,944 cubic yards were inside the canal prism lines and 6,860,500 cubic yards estimated for slides, which estimate includes the amount for benching back of the banks so as to relieve the pressure which, crushing the underlying strata, may either increase the extent of existing slides or cause new ones. The total amount of material due to slides so far removed aggregates 22,570,200 cubic yards, or an increase of 2,304,200 cubic yards over that estimated in the last annual report. Slides and breaks increased as the Cut was deepened. No treatment has proven effective for slides when once developed except that of excavating and hauling away material from the moving mass until the slide comes to rest or until the angle of repose for the particular material in motion is reached.

The predictions of the geologist in the last annual report, with reference to the Cucaracha slide, that "the end of the activity of this slide is now well in sight, however, because all loose surface stone and clay has almost slid off, exposing several large dikes and flows of basalt which would successfully maintain in place most of the remaining material," have not been realized. The bottom grade of the

canal had been reached and the widening cuts had progressed satisfactorily until within approximately 60 feet of the line of the prism was reached on the east side, when on January 20 the basalt rocks broke and there slid into the Cut approximately 2,000,000 cubic yards of material extending completely across the Cut, topping the tracks on the 67-foot level and completely stopping the passage of trains from the north. Bottom grade was subsequently reached for sufficient width to put in drainage pipes for handling the water from the north, but the rains saturating the loosened material occasioned a flattening of the slope, thus causing another movement, and the weight of the superimposed mass broke the pipes. Work was continued on the slide during the year, but principally for the purpose of maintaining the tracks on the 67-foot level open for the passage of trains. This slide at the close of the fiscal year covered an area of approximately 50 acres. The total amount removed thus far since July, 1905, when it began moving, is 3,859,500 cubic yards, leaving approximately 1,500,000 cubic yards still to be removed. The material on the south side of the slide is practically all clay, the middle of it consists of clay and spalls, and the north side of it rock with a mixture of clay. The clay and the clay and spalls can be easily handled by suction dredges, while the material on the north side can be handled by dipper and ladder dredges.

From the West Culebra slide 1,922,700 cubic yards were removed during the year, including material taken from the upper benches, making a total from the time this slide developed in October, 1907, of 8,687,600 cubic yards, leaving approximately 2,390,000 cubic yards to remove, if all the material on the top of the bank is taken out. This slide covers an area of 68 acres.

From the slide at East Culebra 1,676,300 cubic yards were removed during the year, making a total of 5,966,200 cubic yards removed since the slide first developed in January, 1907, and it is estimated that 2,000,000 cubic yards remain. This slide covers an area of approximately 55 acres and extends from the north side of Gold Hill for approximately 5,500 feet.

The shovels on the upper reaches of the East Culebra slide were taken out in August, 1912, and replaced in January, 1913. One shovel was taken from the upper reaches of the West Culebra slide in October, 1912, and replaced in July, 1913; there was at no time less than 1 shovel working at this point.

A break occurred on August 20, 1912, north of the one previously reported at La Pita Point, which turned the Obispo diversion into the canal, flooding it and effectually stopping all steam-shovel work to the north. These shovels were removed, an earth dam built across the Cut south of the break to protect the Cut between it and the summit, which area was then freed from water by pumps; and a tem-



porary channel constructed for the diversion. The shovels were concentrated on the summit stretch and continued there and on the upper banks until the dry season. After a new channel had been excavated for the Obispo diversion the slide was attacked and 181,100 cubic yards removed during the remainder of the year.

On the east side of the Cut, north of Gold Hill, there is a French dump included within the East Culebra slide. A crack developed about April 1, 1913, parallel to the Cut and 635 feet distant from its edge, but it does not join the Cut at any point, beginning and ending on the flat in which it appeared. Steps were taken, by means of steam shovels, to bench this portion of the bank and arrangements made for sluicing as much as possible into the valley to the east.

The summit of drainage in the Cut continued about opposite Culebra until the two shovels cutting to grade on the bottom produced one cut through at grade on June 28, 1913. The water south of the summit was drained into the Pacific through the central culvert of the Pedro Miguel Locks. The dike separating the Cut on the north side from the Chagres River remained intact and the pumping plant previously described continued in service to handle the water which drains to the north from the summit, with the addition of two French centrifugal pumps, 17-inch discharge, added after the break north of La Pita Point.

With the opening in the spillway at plus 50, with the upper gates at Pedro Miguel not complete, it was feared that a heavy freshet might top the dike at Gamboa and do injury to the locks. It was therefore decided to raise the Gamboa dike to elevation 78.2, carrying this elevation along the west dike which separates the west diversion channel from the Cut. The amount of material utilized for this purpose aggregated 37,080 cubic yards.

As cracks developed in the sides of the Obispo diversion, giving the appearance of additional slides which, if they occurred, would let the water of the diversion into the Cut, it was decided to relocate the diversion farther to the east and this was done in three places, one opposite Whitehouse, another opposite the division office at Empire, and another around the break north of La Pita Point. This necessitated the handling of 128,076 cubic yards.

The Lirio drainage channel was changed farther to the west, as the old channel ran so near the Cut that it was liable to break through, and in making this change 27,300 cubic yards were handled.

All trains loaded in the Cut were hauled out at either end to the dumps. On account of the grades that had developed due to deepening the Cut, it was necessary to use an average of seven engines per day as pusher engines to get these trains out in carrying the loaded trains up the inclines at either end. With a contracted area of opera-

tion, the steam shovels were placed closer together and necessitated an average of six locomotives daily to handle the trains to and from the shovels, besides those used in hauling the trains to the dumps.

Due to the development of slides and beginning February 20, 1913, the split-shift system was inaugurated on shovels working in the slides and on the upper benches, so as to secure 12 hours' work per day. While this increased the cost to some extent, it was more than justified, after the decision had been reached to admit the water into the Cut in October, in order to remove as much of the remaining rock in the dry as possible.

The dumps in use during the year were those at Miraflores, Balboa, along the line of the railroad relocation north of Gamboa, swamp lands in the vicinity of Ancon, and a new dump opened along the line of the Panama Railroad south of Pedro Miguel. It was necessary to abandon the old line of the Panama Railroad in the vicinity of Miraflores Locks, to permit the construction of the spillway, and subsequent to March 4 trains had to be operated over the single track through the tunnel. This reduced the number of trains that could be operated to the south and caused the opening up of the Pedro Miguel dump. Material taken from the upper benches on the east side of the Cut was wasted partly in extending the dump north of Gold Hill that was started two years ago, and the remainder was dumped at Miraflores, Ancon, and Balboa, operating over the Gold Hill cut-off of the Panama Railroad. That taken from the upper benches on the west side was wasted on the old dump at Culebra and on the dumps to the south. A total of 284,755 cubic yards were dumped on the east side of the Cut. At Miraflores 1,288,262 cubic yards were wasted; 3,985,129 cubic yards were used for reclaiming swamps at Balboa and wasted on the Balboa dump; 440,725 cubic yards were used for filling swamp lands northeast of Ancon Hill; and 4,376,080 cubic yards on the Panama Railroad relocation dumps between Caimito and Gamboa. During the year 90 acres were filled in at Balboa, making a total of 474 acres in all reclaimed at this point. Between Balboa Y and Sosa Hill 54 acres of marshy land that it was impossible to drain properly were filled during the year. In addition, 487,108 cubic yards of waste material were furnished other divisions and the Panama Railroad.

As previously stated, the Naos Island Breakwater, extending from the shore at East Balboa to Naos Island—a distance of 3.29 miles—is constructed for the purpose of cutting off silt-bearing currents that would fill the excavated channel in the Pacific and make navigation of the channel more difficult by reason of cross currents. As noted in the last annual report, considerable difficulty was experienced by the method of construction then in vogue, which consisted of dumping material from a single trestle extended in advance of the dump. A

plan suggested by Mr. W. G. Comber was considered by a board and adopted. The plan consists of the building of a double trestle extending to Naos Island, dumping to be done on either side, thereby spreading the fill over the treacherous bottom, and carrying it to mean tide as far as the island. When this was done, filling was to commence at the island carrying it to full height. Should the trestle fail, ample length would be left for dumping between the break and the end of the finished portion, while the broken portion was being repaired by pile drivers. On June 30, 1913, the trestle had been entirely completed and filled, with the exception of a stretch about 600 feet long. The total amount of material used for this purpose aggregated 653,242 cubic yards. The soft material was pushed out and up forming a ridge of mud, intermixed with stones that had been dumped in and carried up by the soft material, parallel to the breakwater and at a distance of approximately 100 feet from it. The total amount expended on the dike by the central division and the Pacific division up to June 30, 1913, was \$384,540.89, or about \$22.14 per linear foot.

The average division cost of excavation for the year, including plant charges and all items which entered into its accomplishment, was \$0.5525 per cubic yard. The total amount removed from the central division since American occupation up to the close of the fiscal year was 107,139,181 cubic yards at an average cost of \$0.7105 per cubic yard. Of this total, 93,305,975 cubic yards were removed from Culebra Cut.

Actual construction work on the Empire-Chorrera Road was completed, the convict labor employed on it was transferred to other work, and a small force of paid labor was established for the purpose of placing screenings and doing other work necessary for the completion of the road to the Zone boundary. On November 27, 1912, the construction of a 16-foot macadam road from Gamboa to a point on the Las Cascadas plantation road, about 3,600 feet from the east end of the Empire suspension bridge, was undertaken. This road will have a total length of a little over 5 miles. A stockade was erected at Gamboa to house the prison labor which is engaged on it. The Empire-Paraiso Road was relocated and rebuilt for a distance of 5,608 feet, due to slides along the east bank of the canal. In the village of Culebra 2,370 feet of road were reconstructed on account of slides on the west bank of the canal. At Lirio camp 253 feet of road were constructed. For the preservation of the roads and the comfort of the traveling public the oiling of the highways during the dry season was authorized, and this treatment was applied to approximately 27,000 linear feet of road in the villages of Empire and Culebra. It was necessary to resurface 16,323 linear feet of the Gorgona-Bas Obispo Road.

For the maintenance of water supply to the shops and for other construction purposes, additional pumps were installed and operated at Lirio, Sardanilla River, Gamboa, and Gorgona shops.

Sanitary work consisted in digging 4,698 linear feet of ditches, regrading 602,578 linear feet of ditches, cleaning 1,327,676 feet of ditches, laying 6,426 linear feet of tile drains, constructing 3,852 linear feet of concrete gutters, cleaning 847,852 linear feet of concrete ditches, and clearing 908,331 square yards of brush and grass.

For further information concerning the operations of the central division, attention is invited to Appendix C.

#### FIFTH DIVISION.

As already noted, on the resignation of Mr. S. B. Williamson, the Pacific division was abolished, effective December 12, 1912, and the fifth and sixth divisions of the chief engineer's office organized. The fifth division has charge of the construction of the locks, dams, spillway, excavation in the dry in the canal prism between and below the locks, the operation of Ancon quarry, municipal engineering work within the area covered by the works of the division, and such sanitary engineering work as may be prescribed by the sanitary department within the same area. The work is in charge of Mr. H. O. Cole as resident engineer.

Excavation in connection with the Pedro Miguel Locks was completed during the year by the removal of 3,044 cubic yards from the locks proper at a cost of \$0.4078 per cubic yard. The bulk of the excavation consisted of the removal of the French dump east of the lock site, and the material was utilized for back fill. In addition to the excavation necessary for completing the locks, 2,190 cubic yards were removed for the construction of the northeast core wall built to prevent the passage of water back of the east wall, which might otherwise occur. This excavation was done by hand, and extended under the tracks of the old Panama Railroad which are in use by the central division; the cost was \$3.4297 per cubic yard. To prevent flooding the locks, a cofferdam had been left to the south until completion of the concrete work of the locks, and the subsequent increase in the length of the south approach pier to 1,200 feet prevented its completion until after this cofferdam could be removed. In preparing the foundations for this guide pier and for the wing walls 15,366 cubic yards of material were removed, of which 10,701 cubic yards were rock. The average cost was \$2.3885 per cubic yard. The total amount of excavation for the locks, approach piers, and guide walls, including the preparation of foundations, was 1,319,742 cubic yards, and cost on an average \$1.0248 per cubic yard. The total amount of concrete placed during the year was 58,367 cubic yards, mixed entirely

by auxiliary mixers consisting of two 2-cubic-yard mixers at the north end of the locks on the west side and of an average of 3.05 half-cubic yard mixers which were moved about as necessity required. The concrete was handled either by derricks and locomotive cranes or dumped direct into place through chutes. Of this total 39,465 cubic yards were plain concrete at a cost of \$6.5432 per cubic yard and 18,902 cubic yards were reenforced concrete at a cost of \$9.7989 per cubic yard. The total amount of concrete placed prior to July 1, 1913, in the Pedro Miguel Locks was 906,293 cubic yards at an average cost of \$5.5061 per cubic yard.

The back filling of the lock, wing walls, and center wall was completed during the year, and the riprap finish at the ends of the south wing walls was partially placed. The amount used in the back fill was 367,150 cubic yards, of which 193,212 cubic yards were in the center wall at a cost of \$0.3895 per cubic yard, and the balance behind the side walls at a cost of \$0.4642 per cubic yard. The total amount of back fill placed up to June 30, 1913, was 806,538 cubic yards back of the lock walls at an average cost of \$0.3889 per cubic yard, and 215,149 cubic yards in the center wall at a cost of \$0.4480 per cubic yard.

The west dam at Pedro Miguel, consisting of rock-filled sides and puddled-clay core, was completed and the top finished at elevation 107 with clay. The north face was riprapped with hard stone at the 85-foot level. During the year 114,117 cubic yards of fill were added, making the total in the dam 696,558 cubic yards. The average division cost during the year was \$0.3312 per cubic yard; the average division cost for the entire dam was \$0.4471 per cubic yard.

The Miraflores Locks, including excavation for foundations and the placing of concrete, were carried to completion during the year. The foundation work for the lower west wall was seriously interfered with and retarded by slides and by the water-bearing strata of the banks. In some places it was necessary to build retaining walls to prevent mud from flowing onto the foundation areas, and the slides which occurred carried away the berm-crane tracks, necessitating the use of auxiliary concrete mixers for laying the wall bases sufficiently high to secure a bearing for the berm-crane tracks. Similar difficulty was experienced with the south guide walls, especially on the east side of the locks, which could be built only in small sections. The concrete would be pushed as far as possible, then stopped until another portion of the slide could be removed, and in this way the slide was gradually encroached upon until the guide or flare wall was completed.

The north flare walls are founded on piles; for that on the west side of the locks the piles are driven in a marsh and the weight supported entirely by friction on the piles. While back filling this the portion

of the wall constituting the return bulged slightly, but further movement was checked by depositing material along the face of the return, thus adding a counterweight.

The center approach piers were constructed to the full length of 1,200 feet each from the angle of the flare walls. The north wall is of cellular reenforced concrete construction and is founded on concrete caissons sunk to rock. These caissons consist of reenforced concrete shells  $7\frac{1}{2}$  feet in diameter and 1 foot thick, built up in sections 6 feet long and sunk progressively, the bottom shell being fitted with a steel shoe for a cutting edge. The caissons were sunk to bed-rock at an average depth of 29.43 feet and filled with concrete, thus forming solid columns to rock. They were spaced 15-foot centers longitudinally and 27-foot centers transversely. The wall was then supported on heavily reenforced concrete girders spanning the caissons in both directions. The south approach wall is of massive concrete and is founded on natural rock.

The construction plant, consisting of four berm and four chamber cranes, supplied concrete in the manner described in the last annual report. The total amount of concrete laid in the Miraflores Locks during the year was 450,792 cubic yards, of which 402,607 cubic yards were plain concrete at an average cost of \$5.0273 per cubic yard and 48,185 cubic yards of reenforced concrete at an average cost of \$10.8023 per cubic yard. Of the total amount, 308,914 cubic yards were laid by the four berm cranes. The chamber cranes handled 218,135 cubic yards of concrete and 92,359 cubic yards of fill for the center wall. The concrete was furnished in part by the mixers on the berm cranes and by the 2-yard mixers installed on the east wall which operated from July 1, 1912, to October 26, 1912, producing 97,603 cubic yards. In addition to the regular plant, an average of 3.12 half-yard portable mixers were used throughout the year.

The total amount of concrete laid in the Miraflores Locks up to the close of the year was 1,476,895 cubic yards at an average cost of \$5.0224 per cubic yard. The concrete work in the locks proper was completed on May 17, except the reenforced concrete floor and stairway in the middle wall at the junction of the upper and lower locks, which were completed on June 10. There remain to be completed lamp-post bases, snubbing-button bases, parapets around the stairways, and the nosing at the end of the south center approach pier which was added during the year to the completed plans.

The total amount of concrete laid in the Pacific Locks July 1, 1913, aggregated 2,382,983 cubic yards at an average cost of \$5.2033 per cubic yard.

Back filling the lock walls was continued with material from the locks and prism excavation and aggregated 1,128,769 cubic yards, of which 149,301 cubic yards were in the center wall. The fill back

of the lock walls proper was placed at an average cost of \$0.4068 per cubic yard and that in the center wall and the center approach piers at an average cost of \$0.5973 per cubic yard.

The total amount of the back fill placed behind the walls up to June 30, 1913, was 2,006,054 cubic yards at an average cost of \$0.3466 per cubic yard, and in the center wall 157,213 cubic yards at an average cost of \$0.6182 per cubic yard.

During September and October, 1912, 9,896 cubic yards were excavated for the spillway dam by the hydraulic method. Owing to the limited space and excessive rainfall this method had to be abandoned and no work was done until the beginning of the dry season, when excavation was resumed by the use of steam shovels and also by hand loading into skips which were handled by derricks and locomotive cranes. The situation was complicated due to the fact that the central division tracks for hauling spoil from the Cut to the south passed through the spillway site, and it was desired to give the central division as much advantage during the dry season as possible. It was assumed that the spillway must be completed by September 1, 1913, and to meet this required the removal of the central division tracks from the site by March 1, 1913; this was not accomplished until March 4, and when the excavation of the entire site could proceed it was found that more material had to be removed than was anticipated and consequently a greater amount of concrete was needed. Difficulty was also experienced due to the fact that the Rio Grande passed through the site of the dam and had to be diverted twice. After the concrete for the west end of the dam was brought up to the elevation of the bottom of the river, a dike was constructed confining the water to a space sufficient to enable it to discharge through an opening that was left in the concrete of the dam, and another dike built on the south side to confine the water after passage through the opening. After these were finished further trouble from this source was avoided. To the credit of those engaged in the construction, the structure was completed, notwithstanding the natural difficulties and the delays for which they were not responsible, on September 1, 1913, including the placing of the gates and the erection of the steel work for the walkway on top. The opening for the passage of the Rio Grande must be left until the gates at Pedro Miguel are completed. In addition to the material removed by the hydraulic method, 124,775 cubic yards were excavated by steam shovels, hand, derricks, and cranes, completing the excavation for the spillway dam at an average cost of \$1.6835 per cubic yard.

The total amount of concrete laid in the spillway was 64,142 cubic yards, of which 63,707 cubic yards were plain concrete at an

average cost of \$5.7556 per cubic yard and 435 cubic yards were reenforced concrete at an average cost of \$19.60 per cubic yard. In laying this concrete narrow-gauge tracks were laid from the berm cranes located on the east side of the locks to the south toe of the dam, ending in various spurs leading to derricks which handled the concrete mixed by the berm cranes and delivered on transfer cars in 2-yard buckets. The berm cranes mixed for use at the spillway 27,619 cubic yards, bucket measurement. In addition, an average of 1.43 1-yard mixers and one half-yard mixer supplied 38,551 cubic yards, bucket measurement.

The west dam at Miraflores was completed during the year, with the exception of the junction of the dam with the back fill along the west lock wall. The hydraulic fill in the west dam was completed during the previous fiscal year and the total amount of dry fill added was 418,375 cubic yards at a cost of \$0.4076 per cubic yard. As this dry fill was advanced over the hydraulic fill the softer material was crowded to the center and increased in height and, as it was not sufficiently hard to bear the tracks, an outlet was cut on the west side of the dam through which as much of the soft material as possible was crowded out, assisted by a water jet. What remained was pushed over on the west slope of the dam by raising and crowding the east dry fill. In this way a complete covering was made to full grade, leaving relatively little of the soft material within the dam.

Excavation in the dry between Pedro Miguel and Miraflores Locks and south of the locks was continued throughout the year, the spoil being used for back filling the lock walls, for the dams, and filling in swamp areas on the east and west sides of the canal. The total amount removed during the year was 379,626 cubic yards, car measurement.

In order to divide more equally the excavation between steam shovels and dredges, so as to keep the latter at work, a new dike was built across the canal approximately 3,300 feet north of the old one. After closing down the hydraulic excavating plant which had excavated the area between these dikes to rock at elevation approximately minus 20, the area was drilled to minus 45 and blasted preparatory to being excavated by dredges after the area was rewatered. Steam shovels, prior to turning in the water, took out 59,000 cubic yards of rock. The lower dike was drilled to grade and blown up on May 18, advancing the water to the new dike. The total amount removed below Miraflores Locks by steam shovels was 2,949,943 cubic yards, car measurement.

The total amount of dry excavation in the prism, as shown by cross-section measurements, was 3,120,851 cubic yards, at an average division cost of \$0.6622 per cubic yard.



The Ancon quarry was operated throughout the year with a comparatively small amount of time lost for repairs. It had been in operation for about three years without a general overhauling until May 16, 1913, when it was shut down for 10 days for the putting in of various repair parts, including shaft in main crusher, general overhauling of the four No. 6 crushers, lining up of screens, motors, driving shafts, etc. A small No. 5 gyratory crusher taken from the old Rio Grande quarry was installed on the floor of the south end of the rock bins for the purpose of crushing a portion of the larger rock in order to supply the increased demand for smaller sized stone. The total amount produced was 688,301 cubic yards, of which 424,860 cubic yards were placed in storage, 21,301 cubic yards supplied to the municipal subdivision, and 161,311 cubic yards supplied to other divisions and departments. The total cost of the rock delivered in storage at the locks was \$0.7795 per cubic yard; that furnished other divisions and departments was supplied at a cost of \$0.7853 per cubic yard.

The hydraulic excavating plant continued at work until December 1, 1912, when it was taken out of service owing to the fact that most of the remaining excavation was hard rock. The material removed by this method was used for reclaiming tidal swamp lands east of and adjacent to the canal prism. The total amount removed during the year was 451,631 cubic yards, at a cost of \$1.0113 per cubic yard, making a total removed by this method of 1,549,904 cubic yards, at an average cost of \$0.6959 per cubic yard. At this cost the entire plant charge, \$432,841.92, was absorbed.

This plant was still in serviceable condition, and the suggestion was made by Assistant Engineer W. L. Thompson that at least a part of it be utilized in sluicing the soft material which was found on the north side of Gold Hill and on the top of the east bank of the Culebra Cut. This bank had been to a certain extent stepped back by steam shovels in the process of lightening the loads on the upper part of the bank, but this work was stopped in August, 1912, on the score that Lidgerwood cars could not be spared for this service and that the material could not be handled economically with steel side-dump cars during the wet season. The rain had cracked the bank badly and part of it had sloughed off and fallen into the Cut. To the north and east of Gold Hill lies the valley of the Obispo, and the material excavated by steam shovels on this upper bench has been deposited on the dump extending almost across the valley of the river. By continuing this dump entirely across the valley and by placing culvert pipes through the dam that would result, the water could be allowed to flow through its former channel and the Obispo diversion to the Chagres River. By tilting these pipes upward on the south side of the dam they would form a spillway to any pool that the dam

might make, and calculations indicated that a sufficient pool could be created to furnish water for the pumps to sluice back into the depression to the east some of the clay that would otherwise fall into the Cut. The proposition did not appeal to the officials of the central division, but after the renewed activity of Cucaracha slide it was decided to make use of the sluicing plant for this purpose. The location selected for the pumps and pipe line was such that the rear of Cucaracha Hill could be taken off and washed back into the valley to the east by the use of relay pumps and, further, whatever material remained on the Cut side of Cucaracha Hill could be washed down to the dredges, thereby finishing up Cucaracha slide for good and all. These considerations led to the adoption of this method of sluicing, and the work was placed in charge of the resident engineer of the fifth division. Work on the installation of the hydraulic pumping mains and flumes was started on February 1, 1913. Two boilers and two of the Worthington pumps were erected, with the necessary flumes. The dam has created a lake of approximately 180 acres, with a drainage area of 4 square miles. The elevation at the bottom of the suction at the pumping plant is 214 feet above sea level, and the elevation of the pipes forming the spillway is 228. The material is washed back into the depression which forms the lake, and discharges at such a distance from the pumping plant that the water used in sluicing is returned to the lake and used over again, thus requiring only a small inflow to keep the lake at constant elevation. Sluicing was begun on June 17, 1913, and 57,274 cubic yards were removed by this method at an average cost of \$0.1835 per cubic yard. Booster pumps have been ordered, and when received operations for attacking the rear of Cucaracha Hill will be begun.

To meet an increased demand for water at Ancon and Panama two pressure filters were removed from the Miraflores power house and installed in the Ancon filtration plant. On account of future inundation the 16-inch Rio Grande water main was taken up between Pedro Miguel and the Miraflores power house, and the work of relaying it along the Panama Railroad line was partially completed at the close of the year. Construction work on the locks made it necessary to relay portions of the 10-inch main between the Cocoli pumps and the junction with the 16-inch main at the Miraflores power house.

Grading was completed on the new road from Diablo to Ancon and the macadam was partly placed and rolled at the close of the year. Work on this road included the construction of a 20-foot-span concrete bridge over the Corundu River.

The improvements in the extension of sewer, water, and streets in the city of Panama under the appropriation made by the act of March 4, 1909, of \$800,000, were completed by the expenditure during

the year of \$3,323.95, of which \$2,879.80 was for the purchase of a road roller. The total amount expended in Panama for the improvements up to June 30, 1913, was \$226,289.91.

Work was started on the permanent town site at Balboa in March and included the installation of 750 linear feet of reenforced-concrete storm sewer and 1,222 linear feet of reenforced-concrete drains, filling hydraulically of a portion of the town site with material pumped from the inner harbor excavation, laying out of the permanent laborers' barracks, and the location of the permanent administration building. In connection with the latter, approximately 36,500 cubic yards of material were excavated preparatory to the installation of foundations, concrete piers for the columns were placed, and the erection of the steel frame for the superstructure was begun.

Sanitary work consisted of cleaning 593,127 linear feet of earth drains, excavating 5,079 cubic yards of new earth drains, sweeping 1,023,382 linear feet of cement drains, filling 2,862 cubic yards of holes and swamps, laying 2,520 linear feet of tile drains, constructing 10,566 linear feet of cement drains, and clearing 131 acres of vegetation.

For further information concerning the operations of the fifth division, attention is invited to Appendix D.

#### SIXTH DIVISION.

As already noted, on the abolition of the Pacific division the dredging and the procuring of sand from Chamé for construction purposes were organized into a separate district reporting to the chief engineer. It was decided in February, 1913, to flood Culebra Cut in October, 1913, by removal of the dike at Gamboa, which at present keeps out the waters of the lake. It was estimated that about 350,000 cubic yards had to be removed from the lake section north of Gamboa and that this could be done most economically by dredging; the Cucaracha slide, which consists largely of clay and small spalls, could not be removed economically by steam shovels after the heavy rains had set in, but could be handled efficiently by suction dredges; the conclusion was reached, therefore, that subsequent to the admission of water into the Cut in October the work remaining could be handled most expeditiously and economically by use of the dredging fleet. To get the fleet in condition to handle the work by that time and to take care of what may remain at the entrances, it naturally followed that best results could be accomplished by concentrating all dredging under one head; consequently, effective May 1, this was done, and the division organized with Mr. W. G. Comber in charge as resident engineer.

The fleet available on the Atlantic side of the canal consists of the seagoing dredge *Caribbean*, 5-yard dipper dredges *Chagres* and *Mindi*, French ladder dredges *Nos. 1* and *5*, and five pipe-line suction dredges. One of the pipe-line dredges, after finishing the hydraulic fill in the dam, was overhauled and laid up in Gatun Lake until the water in the lake was of a sufficient depth for it to begin operations north of Gamboa, the other dredges operated within the canal prism north of about milepost 6, covering a length of about 5 miles of the channel, removing therefrom during the year 5,730,379 cubic yards of earth and 753,029 cubic yards of rock, at an average cost of \$0.2093 per cubic yard. On July 1, 1913, there remained to be removed from the prism 1,837,000 cubic yards of earth and 99,600 cubic yards of rock. Of the rock excavated from the channel, 680,176 cubic yards were dumped in the vicinity of the west breakwater, making a total to date furnished by the dredges for this purpose of 1,810,108 cubic yards. Of this amount, 651,000 cubic yards were dumped within the breakwater section proper. In the removal of rock from the channel the drill boat *Terrier* drilled 43,062 linear feet in the prism, breaking a total of 394,526 cubic yards of material. At the end of the fiscal year 40 feet of water could be carried through approximately the first mile and a half of the channel, 35 feet through the next 5 miles, and between this and the locks the depth varied from 10 to 30 feet. The siltage in the canal prism for the year amounted to 2,084,000 cubic yards.

In addition to work in the channel and in the excavation for the wing walls and north center approach pier of the locks already reported, the dredges operated in the vicinity of the new docks at Cristobal, of the dry dock at the same locality, of the mouth of the *Mindi* in the French canal, and of Margarita Island. In the approach channel to the new docks at Cristobal 665,018 cubic yards of earth were removed at an average cost of \$0.0614 per cubic yard, and from the slip between Piers 16 and 17 on the new terminals 155,693 cubic yards of earth and 189,284 cubic yards of coral rock were dredged at an average cost of \$0.3089 per cubic yard. The *Terrier* also drilled 4,511 feet at the site of the permanent bridge across the French canal for railroad connection with the coaling plant, and 34,448 cubic yards of material were broken up by blasting. From the dry-dock basin, to provide mooring berth for the suction dredge *Caribbean*, 3,851 cubic yards were removed, from the French canal at *Mindi* 295,535 cubic yards of earth were excavated, and 100,957 cubic yards were dredged from Margarita Bay and used for parapet and swamp fill in that locality. The site was cleared for the proposed coaling station on Telfer Island.

At the Pacific entrance of the canal there were employed the seagoing suction dredge *Culebra*, 5-yard dipper dredge *Cardenas*, four French ladder dredges, the seagoing ladder dredge *Corozal*, and one pipe-line suction dredge. The pipe-line suction dredge was transferred from the Atlantic end when it had completed its work on the hydraulic fill for the Gatun Dam. It was dismantled, the hull cut in sections and moved over by railroad to Balboa, and after reerection was put in commission on November 16, 1912. For the remainder of the year it was employed principally in dredging material from the site of the proposed inner harbor and terminal basin at Balboa.

The total amount removed from the canal prism during the year aggregated 4,321,956 cubic yards, of which 1,047,929 cubic yards were rock. The average cost during the year was \$0.3238 per cubic yard. At the close of the fiscal year there remained to be removed from the prism 1,847,774 cubic yards of earth and 1,600,000 cubic yards of rock. Of the total amount of rock removed from the canal prism, 121,161 cubic yards were drilled and blasted by the drill barge *Teredo* and 65,953 cubic yards broken by the rock breaker *Vulcan*. The remainder includes rock which had been broken by Star drill operations in previous years and material which could be handled by the dredges without drilling and blasting.

Auxiliary dredging outside of the canal prism aggregated 1,457,342 cubic yards, of which 3,695 cubic yards were of rock. Of this auxiliary work, 1,453,647 cubic yards of earth and 3,695 cubic yards of rock were removed from the inner harbor and terminal basin site. At the close of the year there remained to be removed from the inner harbor and terminal basin, 6,363,240 cubic yards of earth and 372,062 cubic yards of rock. The clearing of this site extended over an area of 1,050,988 square feet and consisted of cutting brush and trees and blasting stumps. An orange-peel dredge excavated 7,800 feet of diversion channel, for draining swamp lands at Balboa to be reclaimed by hydraulic filling.

During the year, 445,658 cubic yards of sand, bucket measurement, were procured from Chamé by dredging and transferred to the sand bins at Balboa at a cost of \$0.5378 per cubic yard in the bins. Of this amount, 435,758 cubic yards were transferred to the stock piles for use in concrete construction for the fifth division at a cost of \$0.7111 per cubic yard in the stock pile. The sand bins had a total length of 260 feet and were provided with 3 rapid unloading cranes until early in May, 1913, when, because the site of the bins encroached upon the terminal work, 1 unloader was removed and the bins shortened to 175 feet. It is proposed to reerect this crane at Gamboa for use in procuring gravel from the Chagres River for various parts of the work.

Arrangements were made by which two suction dredges and the *Corozal* will be moved into Culebra Cut as soon as the locks will permit of their passage and the depth of water is sufficient, with a view to attacking Cucaracha slide. The suction dredges will remove the clay and, assisted by relay pumps located on the 95-foot level on the west bank, will discharge into the Rio Grande Valley. The *Corozal* will handle the heavier material, depositing it in the low areas of Gatun Lake. Anticipating the necessity for completing the Cut by dredges, a contract was entered into on January 16, 1913, for the construction and delivery at Colon of two dipper dredges of the largest and most powerful type in use. They are to be equipped with 15-yard buckets or dippers for dredging soft material and 10-yard buckets for rock. Deliveries are expected at tidewater in the United States, ready for shipment to the Isthmus, December 1, 1913, and January 1, 1914. To serve these dredges six dump scows of 1,000 cubic yards capacity were contracted for under date of June 13, 1913; two of these scows are to be delivered on or before December 12, 1913, two on or before January 27, 1914, and the remaining two on or before March 13, 1914.

For further details attention is invited to Appendix E.

#### SECOND DIVISION.

This division has charge of the design and construction of the terminal facilities, meteorological work, supervision of the mechanical division, and of expenditures and allotments for the work. It is in charge of Mr. H. H. Rousseau, United States Navy, as assistant to the chief engineer.

The act approved August 28, 1902, authorizing the construction of the canal directed the President to "also construct such safe and commodious harbors at the termini of said canal as shall be necessary for the safe and convenient use thereof." The estimate of the cost of the canal, prepared in December, 1908, made provision for the construction of the necessary breakwaters, but did not include anything for such harbor improvements as may be classed as terminal facilities, which had been operated and provided heretofore by the Panama Railroad Co. in connection with the handling of its commercial and other business. Early in the progress of the work it was apparent that the terminal facilities required by the Panama Railroad Co. would not be adequate for the probable needs of shipping that would use the canal, and, in view of the fact that the savings on the estimates would probably enable their construction as a part of the canal work, this was advocated in 1910. Action was taken by Congress in the act approved August 24, 1912, authorizing the President to "establish, maintain, and operate, through the Panama

Railroad or otherwise, dry docks, repair shops, yards, docks, wharves, warehouses, storehouses, and other necessary facilities for the purpose of providing coal and other materials, labor, repairs, and supplies for vessels of the Government of the United States and, incidentally, for supplying such at a reasonable price to passing vessels." The sundry civil act approved August 24, 1912, made the necessary appropriations for the work. While, in anticipation of favorable action by Congress, some preliminary work was undertaken, active operations could not be begun until last fall; consequently the terminal facilities can not be completed by the time the canal is ready for passing vessels.

The Pacific terminals, which are being constructed by the commission, will consist of a main dry dock capable of docking any vessel that can utilize the locks, a smaller dry dock for the use of smaller craft, a plant for supplying coal and fuel oil to vessels, the necessary wharves and piers for commercial purposes, and the permanent shops for use in connection with the dry docks.

The Atlantic terminals consist of wharves and piers at Cristobal, including the Cristobal mole, all of which are being constructed by the Panama Railroad at its own expense, and the main plant for supplying coal and fuel oil to vessels; the cost of the coaling plant will be divided between the commission and the Panama Railroad Co., while the commission will furnish facilities for oil. General drawings showing the layout of these terminals will be found in the annual report for 1912.

As already noted, the larger dry dock will be able to dock a vessel 1,000 feet long and will have an entrance width of 110 feet. The depth of water over the top of the blocks at mean sea level will be 35 feet, at mean high water 41.5 feet, and at mean low water 29.3 feet. This dock will rest on rock and for a considerable portion of its depth will be in solid rock. The general design of the dry docks has been worked out and the preparation of detail drawings commenced. Mitering lock gates, similar to those for the canal locks and operated in the same manner, will form the closure to the dock, and beyond the gates proper a seat for the floating caisson which will be constructed for general canal use. The dock will be flooded by means of longitudinal ducts in the side walls communicating with the dock body through grated openings in the floor along the bottom of the walls. The flow of water will be controlled by four metal "wagon-body" valves operated by suitable machinery. The time required for flooding at extreme high water is estimated at 25 minutes. The pumping plant for emptying the dock will consist of four vertical shaft centrifugal pumps driven by electric motors. The discharge from the pumps will be carried through a concrete duct entirely separate from the flooding ducts. The time required for pumping out is estimated at 2 hours and 20 minutes at mean high

water. Suitable tracks for a 50-ton locomotive jib crane will be provided entirely around the dock. All necessary capstans and bollards will be installed and a pipe tunnel, with suitable outlets, will be constructed around the dock. Stairways leading to the floor will be built on each side at the entrance, on each side at the head, and at two points along the length of each side wall. At the intermediate points arrangements will be made by which material can be passed into the dock. A contract was entered into October 22, 1912, for one pair of steel mitering leaves and fixed irons to be fabricated and delivered on the Isthmus. These gates differ from those for the canal locks in that the miter and quoin ends are to be fitted with green heart bearing pieces, rather than with the metal bearing pieces provided for lock gates. This change was adopted in the interest of increased water-tightness, as the dock will stand dry for the greater portion of the time, and the amount of metal exposed to the action of sea water will be reduced.

The smaller dry dock will have sufficient length to dock a ship 350 feet long, a width at entrance of 71 feet, with a depth of water over the top of the keel blocks at mean sea level of 16 feet 10 inches, at mean high water of 23 feet 4 inches, and at mean low water of 11 feet 2 inches. This dock was substituted for two marine railways originally contemplated, the Navy Department having expressed a preference for such a dock and local conditions favoring it. This dock will be founded on rock, but the greater part of its walls will be of gravity section. The dock will be closed by a floating steel caisson bearing against granite sills when in place. The method of flooding will be similar to that for the larger dock and the flow of water will be similarly controlled. For emptying the dock the pumping plant of the larger dock will be utilized. Access to the floor of the dock will be by means of four stairways, two at the entrance and two at the head; alongside each of the latter two material slides will be constructed. It will be provided with the same accessories as the larger dock.

The wharves and docks contemplated will consist of a quay wall 1,238 feet long between the head of Slip No. 1 and the northeast end of the new Panama Railroad concrete dock, and 1 pier 1,000 feet long by 201 feet wide. Permanent walls will be built at the ends of the slips, each 303 feet wide, and so constructed that part of the length of each will afford landing places for small boats. Including the length of the wharf constructed for the Panama Railroad Co. and completed during the previous fiscal year, the total water frontage under construction will be about 4,650 feet long. The quay walls and all of Pier No. 1, excepting a center section 50 feet wide, will be supported on circular reinforced concrete piers sunk to rock; the 50-foot center section of Pier No. 1 will be rock fill. The slips will be ex-



cavated to 45 feet below mean tide. The elevation of Pier No. 1 and the adjoining wharves at the head of the slips has been placed at 16 feet 6 inches. The level of the quay wall adjoining the Panama Railroad Dock has been fixed at elevation 17, the same level as the Panama Railroad Dock.

The coaling station on the Pacific side will be adjacent to the site of the dry dock and will be capable of handling and storing 100,000 tons of coal, with a possible increase of 50 per cent. Subaqueous storage will be provided for 50,000 tons. Specifications were issued for the coal-handling plants at the two terminals and proposals asked for plants in accordance with the general specifications. These plants are to be delivered and erected in place by the contractor, the substructure and all other work in connection therewith to be performed by the commission with its own forces. Bids were opened on June 14, and when the award is determined plans conforming with the machinery will be prepared for the substructure. The specified rate for unloading coal from vessels into the storage piles has been fixed at 250 tons per hour for each machine, and the desire is to unload two vessels at one time at the Atlantic plant, with two unloading machines to each vessel, and one vessel at the Pacific plant with two machines. The reloading capacity—that is, transferring coal from storage into collier or barge—has been fixed, after consideration of the reloading capacity of modern commercial plants in the United States, at the rate of 500 tons per hour for each machine. It is proposed to equip the Atlantic plant so that two vessels can be loaded at one time, with two machines serving each vessel, and on the Pacific side so that one vessel can be loaded with two machines.

The main machine shops were located at Gorgona, which will be flooded by the lake as the waters rise. The shops at Balboa and Cristobal, in connection with the shipways and dry docks at these localities, were generally adequate for the maintenance and repair of the dredging fleet. With the adoption of the policy of giving repair facilities to any vessel that could use the locks, as well as to the Navy, the construction of new shops near the dry docks became necessary. The permanent shops proper will consist of 18 buildings for the machine, erecting, and tool shops; forge shop; steel storage shed; boiler and shipfitter shop; general storehouse; paint shop; car shop; planing mill; galvanizing plant; lumber and equipment shed; pattern storage; foundry; coke shed; boiler house; roundhouse; gas house; paint house; and sand house. In addition to an office building, there will be 9 auxiliary buildings.

On the Pacific terminals preparatory work was begun as indicated in the last annual report and, when funds became available, operations were pushed as rapidly as possible. The site was cleared by the removal of the settlement at Balboa, as well as the buildings

which formed the old town. The Panama Railroad yard was abandoned after a new yard and track facilities were provided for temporary use. Considerable difficulty was experienced in carrying on the work expeditiously and economically because of the interests of other divisions and departments whose work and operations could not be interrupted. To provide room around the head of the location of the main dry dock for tracks and a highway leading to the old French pier, the northwest slope of Sosa Hill was removed, 184,682 cubic yards of rock and 181,729 cubic yards of earth, or a total of 366,411 cubic yards being excavated. The total quantity excavated in preparing the site was 389,567 cubic yards at a cost of \$0.5447 per cubic yard. The greater part of this material was used to fill in the adjacent swamp to bring the area up to the adopted grade, and some of the rock was furnished the Atlantic division for paving the south slope of Gatun Dam. The original surface elevation of the dry-dock site was 18; the deepest general excavation for the foundation will therefore be about 74 feet. The lowest shovel cut on June 30 was at 12 feet below sea level, on the coaling-plant site at the southwest end of the excavation. From this site 203,699 cubic yards of material were removed, at an average cost of \$0.8461 per cubic yard, of which 56,900 cubic yards were rock. The site for the smaller dry dock is at present occupied by the shipways and shops of the dredging division, which can not be abandoned until other repair facilities for floating equipment are available elsewhere. To protect the entrance of the main dry dock and the entire area to be occupied by the smaller dock, and to enable the removal in the dry of as much rock as possible from the entrance basin of the main dry dock, as well as to facilitate the construction of the coaling-plant quay wall and basin, a cofferdam composed of clay riprapped with rock around these various works was begun on April 1, 1913. When complete it will be about 1,000 feet in length.

For the construction of the quay walls and pier the rock is found at an average elevation of 60 feet below mean tide, in some cases being as high as 33 feet and in others as low as 66 feet below this level. The elevation of the original swamp was about 9 and the material through which the concrete cylinders are to be sunk is a fine, sticky, black clay with thin strata of sand. The cylinders are sunk by the open-caisson method. They consist of sections of reenforced concrete shell in 6-foot lengths, 1 foot thick, and  $7\frac{1}{2}$  feet outside diameter. About 4,750 sections are required and a special plant for their manufacture was built. Steel collapsible forms are used. The bottom section of each cylinder is 8 feet outside diameter and 6 inches thick, with a cutting shoe on the bottom. Excavation was done by hand and by orange-peel buckets. When the cylinders would not sink of their own weight, their descent was facilitated by the use of cast

iron and concrete weights in conjunction with the water jet. It was not considered advisable at this late date to increase the plant, so that the progress of sinking the cylinders depended on the crane service available. After the cylinders were sunk several feet into rock they were filled with concrete. They are to be capped by reenforced concrete beams for supporting the floor. The area within which the quay walls and pier are to be constructed was inclosed by a dike which was begun in July of 1912. During the year, of the 28,500 feet of cylinders that will be required to complete the work, 12,435 feet were placed. Of this amount, 8,450 feet were for the main quay wall, 289 feet for the walls at the head of Slips 1 and 2, and 3,696 feet for Pier No. 1. The cost of these cylinders in place averaged \$18.4708 per linear foot.

During the year the greater portion of the area to be occupied by the shops was brought up to grade by filling the low swampy land with material made available by excavating operations. The natural surface of the ground was not sufficiently stable to hold up the buildings, so it was found necessary to reach rock for the foundations by excavating to it where sufficiently near the surface, or by driving piles to the rock, which in places was as low as 56 feet below sea level. Near the water front it was necessary to use 4-foot steel cylinders, filled with concrete and sunk to rock, as foundations. During the year the number of piles driven was 3,750 at an average cost of \$0.4820 per linear foot, and 7,787 cubic yards of concrete at a cost of \$9.2091 per cubic yard were placed in the footings and in the tunnel.

An operating tunnel, running through the center and at right angles to the length of the main shop buildings, is under construction for carrying and making accessible all pipe and cable conduits. The main trunk will have a clear height of 6 feet and a width of 4 feet 6 inches, and with branches of the same height and a width of 3 feet 6 inches. The tunnel will contain all power, light, telephone, and fire-alarm cables, and water, steam, fuel-oil, and compressed-air mains, and the main sewer. Rain water will be carried off the area occupied by the shop buildings by means of surface gutters and drains. For its construction a steam shovel mounted on skids, with a special boom, commenced work on March 20, 1913. Where hard rock is not deeper than about mean sea level the tunnel was built on piers excavated to rock. At all other points it is carried on wooden piles driven to rock and cut off below the mean elevation of ground water. It is built in sections 15 feet in length, special means being provided to make the tunnel as water-tight as practicable.

Work was started on June 5, 1913, on the foundations for machines for the planing mill; a considerable portion of the concrete

necessary for these and for the floor of the building was completed during the year.

A little more than 25 miles of track were laid during the year, of which amount 9,212 feet were permanent tracks for the use of the Panama Railroad, the remainder for construction purposes. The road at the foot of Sosa Hill, which had to be reconstructed, was 3,300 feet long.

The steel framework for the shop buildings, aggregating about 6,000 tons, is being furnished and erected under contract dated October 22, 1912, at \$0.036 per pound for the main buildings. A supplemental order was given on January 25, 1913, for the steel for nine toilet buildings and one paint house. The rolling of the steel began the last week in February and the first shipment left Baltimore on March 30. On June 30 the status of the work was about as follows: All the material had been rolled in the mill, 66.5 per cent finished in shops, 56.5 per cent shipped to tidewater, and 43 per cent shipped to the Isthmus.

A contract was made October 24, 1912, for 6,500 squares of reenforced cement tile roofing for all quarter-pitched roofs of the machine shops at \$10.25 per square delivered and \$13.25 per square erected in place, the commission furnishing certain materials, such as sand and cement, and facilities, such as suitable buildings, power, and water. All tile is being manufactured on the Isthmus, at Paraiso. The contract required all plant to be on the Isthmus by January 25, 1913, and the completion of manufacture by June 25, 1913. At the close of the year 49.12 per cent had been manufactured and 7.9 per cent had been laid.

For the Atlantic terminals the quay wall and one pier were practically completed by the Panama Railroad during the year, the material purchased for the steel work for the sheds, and a subsequent contract made for its erection. The Panama Railroad also made diamond-drill borings at the site of the coaling station, and work was begun by the dredging division in June, 1913, on drilling and blasting preparatory to dredging alongside the proposed coaling pier.

In designing the permanent shops the principle was aimed at to reduce to a minimum the cost of repairs and renewals, without exceeding a reasonable first cost. Steel was therefore adopted for the main structural material, for which the only cost for maintenance will be repainting from time to time. The roofing, consisting of reenforced cement tile on the quarter-pitched roofs, should last indefinitely, with practically no cost for maintenance and repairs, and presents a pleasing appearance. Such buildings as have flat reenforced concrete roofs will be waterproofed with first-quality composition roofing. There will be practically no gutters or down spouts, except for drainage of valleys, in which cases copper and similar permanent construc-

tion will be employed. Buildings which require it will be closed in with walls of hollow terra-cotta tile, plastered with cement mortar; other buildings, such as the main metal and wood working shops, which do not require to be closed in, will be surrounded with a concrete wall 3 feet 6 inches high, above which there will be movable metal shutters or louvers as protection against wind and rain. The pattern shop and storehouse will have a second floor consisting of a reenforced concrete slab resting on steel beams and girders incased in concrete. The lumber shed and steel-storage shed will have the first floors surfaced with cinders, sand, or gravel. In the main shops the floor will consist of a concrete base covered with 3½-inch creosoted wooden blocks.

The selection and location of equipment in the different shops was practically completed during the year. The greater number of the machines and tools for the permanent shops will be taken from the present shops. While many of them have seen hard service and are less efficient than those of recent design, it is considered economical to install and use them until the character and quantity of work to be performed by the new plant become definitely known, so as to enable the types and sizes of machines best adapted to the work to be selected. Electric power at 44,000 volts is to be delivered by the transmission line to a substation adjacent to the pump well of Dry Dock No. 1, where the voltage will be reduced to 2,200 volts for distribution. The shops have been arranged in four groups as regards electric distribution and each group provided with transformers and switchboards for reducing the voltage. All power used in the plant will be 3-phase, 25-cycle, 220-volt, except 220-volt direct current in the machine shop for variable-speed tools. Duplicate motor-generator sets will be installed in the machine shop for furnishing the current required.

In anticipation of requirements that will develop after the completion of the canal, investigations and inspections were made during the past two years of the principal floating cranes in the United States and Canada, as well as abroad, with a view to determining the type of crane that will best meet canal requirements. The conclusion was reached that two floating cranes of the largest size would be necessary to meet the conditions that might arise in handling lock and dock gate leaves. These cranes will also be required, as regards lifting capacity, to meet the requirements of the Navy Department. On October 30, 1912, proposals were invited for the delivery of two floating cranes of the revolving type, having a maximum lifting capacity of 250 gross tons. Award was made April 17, 1913, to the Deutsche Maschinen Fabrik, A. G., for approximately \$827,550 for the two cranes, to be delivered in 580 days.

An investigation and inspection of the most modern and largest harbor tugs in use on the Atlantic coast of the United States and in the leading ports of England was also made during the last two years, and the estimates for the fiscal year 1913-14 included an amount considered sufficient for the purchase of four such tugs. Arrangements were made at the close of the past year for the preparation of plans and specifications for suitable tugs for the purpose.

Numerous applications have been received from coal dealers for loading space for the handling of their coal in supplying vessels that will use the canal. No authority exists for leasing any land or land under water in the Canal Zone, except the act of February 27, 1909, which provides for the leasing of land for agricultural purposes only. It was never intended that the Government should exercise a monopoly of the coal business on the Isthmus, but to utilize the coal stored here for the use of the Navy in maintaining uniform prices of this product to shipping. In order to encourage individuals and companies in the business of furnishing coal to vessels which use the canal, the policy has been adopted of providing storage in connection with both coaling plants for the coal piles of individuals and companies who desire to participate in the business. There will be a certain rental charge for the areas and, in addition, a real estate tax of 1 per cent of the value of the improvements, should any be made, and a merchandise tax of 5 cents for each 2,000 pounds of coal sold. The Government will do all the handling and charges for putting the coal into storage and taking it out, charges for the use of coal barges, and other labor in connection with this service will be fixed at cost price to the Government for such service. The same policy was adopted with reference to oil. It is proposed to equip the wharf in the vicinity of the coaling station at the Pacific terminus and docks 13 and 14 at Mount Hope on the Atlantic side with fuel-oil supply and delivery mains in duplicate, together with the necessary pumps, so that the Government will be able to handle satisfactorily all fuel oil, including fuel oil of individuals and companies who may wish to participate in the fuel-oil business on the Isthmus, on the same general terms as those applying to the coal business.

A contract was entered into on October 1, 1912, for four storage tanks 93 feet in diameter and 35 feet in height, each having a capacity of 40,000 barrels, to be erected complete at a total cost of \$62,800. At the end of the year these tanks had been practically completed, two at Mount Hope and two at Balboa dump, southeast of Sosa Hill, and plans are under way to connect them with the water front.

Three first-class meteorological stations at Ancon, Culebra, and Colon were continued throughout the year, each with a full complement of instruments and in charge of a skilled observer. Wind

records were kept at Gatun, Pedro Miguel, Sosa, and Miraflores. Twenty-six rainfall stations were in operation, 15 of which were equipped with standard and 11 with automatic rain gauges. Evaporation stations were maintained at Ancon, Rio Grande, Gatun Lake, Brazos Brook reservoir and Colon. Seismograph stations were in operation at Ancon and Gatun. Duplicate automatic tide registers were located at Colon and Balboa. For use by the Fortification Board, maximum and minimum temperatures were recorded on the Miraflores dumps. Regular gauging work was discontinued on the smaller streams at the end of the year 1912, the work being interfered with by backwater from Gatun Lake.

The most important hydrological change during the year was the rise of Gatun Lake. On July 1, 1912, the elevation was 31. The stage of the water fluctuated, as regulated at the spillway, reaching an extreme height of 56.28 feet above sea level on November 29. From studies made it appears that the lake basin is subject to very little seepage or other underground losses. The records of the Chagres River and its tributaries show the calendar year, 1912, to be second in order of dryness since American occupation in 1904. The largest freshet since December, 1910, occurred on November 28 and 29, 1912, when there was a rise of 19.6 feet at Vigia and of 12.3 feet at Alhajuela, the discharge at the latter point being 54,000 cubic feet per second.

The average temperature for the calendar year 1912 was well above normal, especially during the dry season. March was the warmest month at Ancon and April at Culebra and Colon. The highest temperatures recorded in April—97° F. at Ancon and 96° F. at Culebra—established new high temperature records at these stations. November was the coolest month at all stations, the minimum recorded being 65° F. at Culebra.

The rainfall during 1912 was below normal everywhere except immediately along the Pacific coast, although generally heavier than the annual rainfall for 1911. The heaviest precipitation was 147.61 inches, at Porto Bello, and the minimum rainfall was 71.78 inches, at Ancon.

There was a notable excess in wind movement during 1912. The average velocities were abnormally high during the dry season; a maximum velocity of 49 miles an hour from the east was recorded at Gatun. The prevailing direction was from the northwest at Ancon and Culebra and from the north at Colon. The relative humidity was generally below normal, the mean being 81 per cent at Ancon, 82 per cent at Culebra, and 83 per cent at Colon.

A number of seismic disturbances were registered, but none was so violent as to be sensibly felt in the Canal Zone.

Surveys were made of the Miraflores Lake watershed, Corozal Hospital farm, Darien Radio Station reservation for the Navy Department, Chagres River from Gamboa to the Zone boundary to locate gravel banks, and the area in the vicinity of Mount Hope proposed for oil storage. The boundary line between the city of Panama and the Canal Zone was run out and monuments located. An error of 100 meters was found in the recorded distance between triangulation stations Gamboa and Obispo, the recorded distance being 1,093.34 and the correct distance 1,193.34 meters. Considerable survey work was also done for the department of law and the joint land commission.

Further details concerning the work of the second division will be found in Appendix F.

The mechanical work, performed by the mechanical division and elsewhere on the Isthmus, will be found in report of Lieut. Col. T. C. Dickson, United States Army, forming Appendix G.

#### CONSTRUCTION OF THE NEW PANAMA RAILROAD.

The construction of the new line of the Panama Railroad was practically completed on May 25, 1912, when the portion of the line from Gamboa to Pedro Miguel and back of Gold Hill was turned over to the railroad company and accepted. Work during the year consisted of riprapping the slopes of the embankments through the Gatun Lake section, building a lift span of the bascule type in the bridge spanning the Gatun River at Monte Lirio, and installing automatic signals throughout the line. The work was in charge of Lieut. Frederick Mears, United States Army, chief engineer of the Panama Railroad.

Material from Culebra Cut was utilized during the year in strengthening the embankments near mile posts 20, 21, and 24, and also the embankment in the Brazos Valley. The total amount of material used for the purpose was 257,831 cubic yards.

The bridge across the Gatun River at Monte Lirio consists of the three plate-girder spans formerly used on the old line of the railroad for crossing the Chagres River at Barbacoas. The center span, a 103-foot plate girder, was converted into a lift span by the addition of lifting trusses, lifting mechanism, and counterweight. It will provide a channel 80 feet wide in the clear, with a depth of 45 feet of water, thus giving ships access to the large area of the lake which lies east of the railroad. The necessary materials were purchased under contract for the sum of \$24,390, and the bridge was erected by the forces of the Panama Railroad at a cost of \$59,611.20, including a combined operator's house, block office, and interlocking cabin.

Automatic signals were installed from Mindi to Corozal, with the exception of about 4 miles between Caimito and Gamboa cabin, where



the main tracks are not on permanent grade and alignment. The signals placed between Pedro Miguel and Corozal were removed when it became necessary to use the new line of the railroad for the passage of dirt trains to enable the cutting of the old line for the construction of the Miraflores spillway.

For further details, attention is invited to Appendix H.

#### FORTIFICATIONS.

By the act approved August 24, 1912, an appropriation of \$1,000,000 was made for the gun and mortar batteries for the defense of the canal against naval attack, making the total appropriated \$3,000,000, which is sufficient for the completion of this portion of the work. In addition, \$200,000 were appropriated for land defenses.

Work was continued during the year on the gun and mortar batteries. The detailed surveys necessary for the location of land defenses were well advanced to completion and arrangements made to begin work on July 1, 1913, on the construction of redoubts in accordance with plans prepared by a board appointed for the purpose and approved by the Secretary of War.

During the year 416,542.5 cubic yards of excavation, at an average cost of \$0.9225 per cubic yard, were done; 131,952.8 cubic yards of concrete, at an average cost of \$7.0670 per cubic yard, were laid; 93,808 linear feet of piling, at a cost of \$0.4311 per linear foot, were driven; and 100,957 cubic yards of filling, at a cost of \$0.1720 per cubic yard, were done by one of the dredges. The amount expended for gun and mortar batteries was \$1,432,767.01, for surveys \$41,790.95.

The work was in charge of Lieut. George R. Goethals, United States Army, assisted by Lieut. A. H. Acher, United States Army, and Mr. R. M. Elder and Mr. H. P. Warren as superintendents of construction.

#### COST KEEPING.

The methods of cost keeping adopted on January 1, 1910, were continued throughout the year. In addition to those reported a year ago, cost accounts were initiated for the erection of permanent buildings, the construction of the electric-transmission line across the Isthmus, and the preparation of permanent town sites. The cost accounts of the first division, which include the erection of the lock gates, emergency dams, lock-operating machinery, and aids to navigation, were revised so as to furnish better information. Supervision of cost data for the construction of a concrete dock at Gatun and of a bridge across the French canal at Mount Hope to connect with the site of the Cristobal coaling plant were added to the duties of

the office. These projects, as well as the construction of the dock at Cristobal and of the new Washington Hotel at Colon, are in charge of the Panama Railroad Co., and their costs are not included in this report. The costs are made up of the labor engaged in and the material applied to the work, an arbitrary to absorb the cost of the plant, and a proper proportion of the division overhead charges. The general expenses of the commission are prorated to the different parts of the work and must be added to the division costs in order to determine the total costs. As the division engineers do not necessarily have control over the items which make up these general expenses, the costs reported are the division costs, except where noted to the contrary. The cost-keeping accountant, Mr. Ad. Faure, reports directly to the chief engineer. His duties consisted, up to October 1, 1912, in supervising and verifying the statements of costs furnished by the division engineers, establishing accounts for new work, and preparing statistical data. On October 1 the preparation of the detail costs for the aids to navigation was transferred to his office; on January 1 that for the reorganized divisions of the former Pacific division and for the first division of the chief engineer's office; and on April 1 that for the Atlantic division. Although the details of costs furnished have greatly increased in the past year, the expense of securing this data has decreased from about \$3,600 per month to \$3,000 per month.

In the distribution of general expenses, the central division continues to carry the larger proportion, due to the fact that prior to 1907 but little work was done except in this division, so that all the overhead charges were properly added to it.

Excavation by steam shovels in the central division shows an increased cost over last year of \$0.0410, the principal item of increase being in the cost of repairs to equipment—\$0.0297.

In the Atlantic division the costs for dredging in the prism were lower this year than last, due to the larger ratio of material excavated by pipe-line suction dredges. In the Pacific division the cost was higher than last year, due to the larger ratio of rock excavation and the increased depth, which is attended with additional expense because of the great tidal variations.

Hydraulic excavation in the channel below Miraflores Locks was concluded in November, 1912, and the plant reerected at a point north of Gold Hill to sluice the top banks in order to relieve the pressure. Operations began on June 16, and to the close of the fiscal year 57,274 cubic yards of material had been removed, at a division cost of \$0.1835 per cubic yard, including an arbitrary of \$0.1000 per cubic yard for plant. This work is being performed by the fifth division, chief engineer's office.

There was a total of 771,907 cubic yards of masonry laid in the locks and spillways during the year, as against 1,443,570 cubic yards during the previous year. This is inclusive of masonry laid by the first division in connection with the installation of operating machinery. The costs per cubic yard for the masonry were: Gatun Locks, \$7.2794; Gatun spillway, \$8.1227; Gatun power house, \$8.5739; Pedro Miguel Dam, \$5.0240; Pedro Miguel Locks, \$7.5976; Miraflores West Dam, \$4.3330; Miraflores spillway, \$5.8497; Miraflores Locks, \$5.6445. Plain concrete shows increased cost over last year in all projects, except Gatun Locks, due to reduced quantities of concrete laid and to the use of a larger ratio of auxiliary mixers. At Gatun Locks plain concrete shows a decrease of \$0.5934, principally in the cost of sand and stone, in the expense for steel forms and in the arbitrary for plant, the decrease in the cost of sand and stone being due to readjustment of stock prices (revised cross-section measurement of the stock piles having shown more stone in storage than was carried on the books), and to securing sand from the borrow pit at Gatun instead of from Nombre de Dios. At Miraflores Locks plain concrete shows an increase of \$0.4406 per cubic yard, principally in cement, mixing, wood forms, and placing. Fluctuations in the cost of reenforced concrete are due to the different classes of reenforced concrete laid during the two years.

The dam at Gatun was increased by 1,714,367 cubic yards of dry fill at a division cost of \$0.3755 per cubic yard, and 169,114 cubic yards of hydraulic fill at a division cost of \$0.2654 per cubic yard. At the close of the year there were in place at Gatun Dam 11,578,268 cubic yards of dry fill at a cost of \$0.4063 per cubic yard, and 10,124,082 cubic yards of hydraulic fill at a cost of \$0.2933 per cubic yard.

During the fiscal year 1913 no filling for the Colon Breakwater was secured from Toro Point; 183,762 cubic yards of large rock secured from Porto Bello quarry were placed in the breakwater at an average division cost of \$4.8250 per cubic yard. This yardage is the volume of rock in the bank. Last year 65,133 cubic yards of this rock were placed in the breakwater at a division cost of \$4.3064 per cubic yard.

The Ancon quarry alone was operated during the fiscal year and produced 688,301 cubic yards of crushed stone at an average cost of \$0.7795 delivered in storage. To the close of the fiscal year this quarry had produced 2,558,578 cubic yards of crushed rock at an average cost of \$0.8572 per cubic yard delivered in storage. The Porto Bello quarry, which began operations in March, 1909, and closed down in April, 1912, produced 1,921,929 cubic yards of crushed rock at an average cost of \$2.4337 per cubic yard delivered in storage. There was secured from the Chamé sand pit 445,658 cubic yards of

sand at an average cost of \$0.7111 per cubic yard delivered in storage. To the end of the fiscal year there has been secured from this source 1,741,196 cubic yards of sand at an average cost of \$0.7666 per cubic yard. From the pit at Nombre de Dios on the Atlantic side, which was opened in March, 1909, and closed in November, 1911, there was secured 785,893 cubic yards of sand at an average division cost of \$1.9176 per cubic yard delivered in storage. During the year there was secured from the borrow pit near Gatun dam 43,851 cubic yards of sand at an average cost of \$0.5188 per cubic yard.

To the close of the year the following amounts had been expended: On spillway gates and caissons at Gatun, \$73,732.22; at Miraflores, \$40,625.69. On spillway gate machines and their erection, at Gatun, \$91,122.95; at Miraflores, \$64,299.22. On lock gates and their erection, at Gatun, \$2,225,084.30; at Pedro Miguel, \$1,373,537.13; at Miraflores, \$1,233,845.37. On fender chains, at Gatun, \$3,836.95; at Pedro Miguel, \$21.37. On emergency dams, at Gatun, \$816,184.77; at Pedro Miguel, \$512,480.47; at Miraflores, \$38,803.75. On lock operating machinery, including towing-track system, concrete used in the installation of machines, etc., at Gatun, \$2,592,232.64; at Pedro Miguel, \$1,361,873.92; at Miraflores, \$1,561,817.40. For the towing-track system the following number of linear feet of return track were laid by the construction divisions at the various locks: Gatun, 10,527, average division cost \$1.3261; Pedro Miguel, 4,333, average division cost \$1.1065; Miraflores, 5,925, average division cost \$2.5637; and by the first division at Gatun, 1,449, average division cost \$1.9273; at Pedro Miguel, 2,043, average division cost \$2.3678; at Miraflores, 1,082, average division cost \$0.6085 per linear foot. The number of linear feet of track, with rack installed by the first division, and the average cost per linear foot were: At Gatun, 21,000, average division cost \$2.3128; at Pedro Miguel, 12,199, average division cost \$2.0180; at Miraflores, 14,137, average division cost \$1.2291.

In connection with the erection of operating machinery, installation of towing tracks, and decking, the first division had laid to June 30, 1913, 36,710 cubic yards of concrete as follows: At Gatun locks, 16,706 cubic yards, average division cost \$13.4124 per cubic yard; at Pedro Miguel Locks, 10,190 cubic yards, average division cost \$12.1460 per cubic yard; at Miraflores locks, 9,814 cubic yards, average division cost \$11.3013 per cubic yard.

The total expenditures for aids to navigation to the close of the fiscal year had been \$377,041.63.

For the Cristobal terminals \$14,488.14 had been expended, and for the terminal facilities at Balboa \$1,943,971.09. There had been excavated in preparation of site 412,707 cubic yards of material at an average cost of \$0.5620 per cubic yard. In filling, 505,419 cubic yards of material had been used at an average cost of \$0.3992 per

cubic yard. There had been dredged in preparation of the inner harbor at the latter point 1,771,814 cubic yards at an average cost of \$0.1547 per cubic yard. For the main dry dock there had been excavated 145,478 cubic yards of material, and for the coaling station 58,221 cubic yards, at an average cost of \$0.8461 per cubic yard. In preparing the foundations for the shops 29,684 cubic yards of material had been removed at an average cost of \$1.5607 per cubic yard; 7,787 cubic yards of concrete had been placed at an average cost of \$9.2091 per cubic yard; 135,442 linear feet of wood piles and 3,060 linear feet of concrete piles had been driven, at an average cost of \$0.4820 and \$3.2358 per linear foot, respectively. In constructing the docks 12,435 linear feet of concrete caissons were placed at an average cost, including excavation, of \$18.4708 per linear foot.

There had been expended in the preparation of permanent town-sites \$52,458.77 and in the construction of permanent buildings \$55,918.76. In the preparation of foundations for the administration building 38,073 cubic yards of material had been excavated, at an average cost of \$0.5654 per cubic yard, and 770 cubic yards of concrete had been laid in the foundations at an average cost of \$12.8646 per cubic yard.

The amount paid for salaries of clerks and supervisory forces during the fiscal year was 19.75 per cent of the total amount disbursed for salaries. Last year it was 20.55 per cent, indicating a saving in clerical and supervisory forces of about \$185,000.

For further details concerning the cost of the various parts of the work and the performance of the different plants, attention is invited to Appendix I.

#### QUARTERMASTER'S DEPARTMENT.

The quartermaster's department is charged with the recruitment of labor; care, furnishing, and assignment of quarters; distributing fuel, commissary supplies, and distilled water; construction and repair of all buildings; requisitioning for supplies of all kinds, together with the receipt and distribution of them on arrival; cutting of grass and disposal of night soil and garbage as prescribed by the sanitary department; and the auditing of all property returns. The department was in charge of Brig. Gen. C. A. Devol, United States Army, until April 17, 1913, when, on account of ill health, it was necessary for him to relinquish his position with the commission. On May 27, 1913, Capt. R. E. Wood, United States Army, was appointed chief quartermaster and continued in charge for the rest of the year.

The force employed increased steadily during the first nine months of the year, until on March 26 the number reached the highest point in the history of the canal work; on that date the effective working force was 44,733, of which 39,089 were on the pay rolls of the com-

mission and the Panama Railroad and 5,644 on the pay rolls of the contractors handling the work on the lock gates, emergency dams, and other contracts in connection with the work. The force fluctuated between 34,957 on June 30, 1912, to the maximum on the date specified, and numbered 43,350 at the close of the fiscal year. In December, 1912, it became necessary to recruit laborers, and 528 were received from Barbados during January and February, 1913. There was a decided decrease in immigration to the Isthmus as compared with previous years, the excess of arrivals over departures amounting to but 3,510. The average number of American employees on the rolls of the commission during the year was 4,340 and on the rolls of the Panama Railroad 870, or a total of 5,110. During the same period there were 2,495 separations from the service of the commission, 1,010 persons employed in the United States and 1,331 employed on the Isthmus, indicating that more than 57 per cent of the gold force was changed.

The commission has 2,618 buildings in the Canal Zone, of which 1,856 were constructed by the Americans and 762 by the French. This is a decrease of 121 from the total of the preceding year. The buildings located at Nombre de Dios, which had been abandoned when this locality ceased to be used as a source of sand supply, were sold. In addition, 122 were demolished and 4 blown down or destroyed by fire. Those demolished were located at Bas Obispo, Culebra, Balboa, and Naos Island, and the destruction was necessary by reason of the work or on account of slides. Those demolished were small and of no value. New construction during the year was less than at any previous time; 20 new buildings were put up and 15 additions made to existing ones. The buildings were small and only two cost over \$2,000. The additions as a rule were chargeable to the Hotel Tivoli. Due to the slides at Culebra and the necessity of transferring buildings from Gorgona and old Balboa, the work of removal and reconstruction was on a large scale. Sixty-two buildings were taken down in sections and reconstructed in new locations. The cost of the completed work amounted to \$142,000, not including buildings in the course of reconstruction on June 30, 1913, on which \$33,000 had already been expended. Up to April 1 the new construction, moving, and part of the maintenance work were handled by five traveling gangs of carpenters. All the American buildings in Gorgona had to be removed and reerected by September 1, 1913, so that nine new gangs were formed in order to complete this work on schedule time. The average cost of taking the buildings down in sections and reconstructing them in new locations during the year was a trifle less than one-third the original cost of the buildings, or a saving over the cost of similar work done during the previous year. It was found on reerection that the buildings were fully equal in

value to the original investment, as all unsound lumber was replaced, new plumbing connections put in, and the houses entirely repainted.

On June 30, 1913, there were 23,184 men, women, and children occupying commission quarters, practically the same as during the previous year. Of these, 9,173 were in gold quarters, 4,295 were in European quarters, and 9,716 were in West Indian quarters. Over 90 per cent of the American and European employees occupy commission quarters, but less than 25 per cent of the West Indians take advantage of them. The problem of housing employees properly was a difficult one. Because of the opening up of the terminal work there was a congestion, especially in bachelor quarters, in this territory. To meet the conditions it was necessary to move and reerect a large number of houses for use as quarters. The demolition of the old settlements of Balboa and Gorgona complicated the situation. In moving Gorgona it was necessary to care for 200 American families, 600 American bachelors, and several hundred West Indians who occupied commission quarters, and these were provided for at other points. This movement began in March and was almost completed at the close of the year.

The value of material received from the United States during the year was greater than for any preceding year; it amounted to \$13,980,071, not including \$2,535,860 paid to the McClintic-Marshall Construction Co. or the value of local purchases on the Isthmus amounting to \$2,733,867. The consumption of cement decreased from 1,600,000 barrels in 1912 to 1,200,000 barrels in 1913; the total consumption to date amounted to 5,797,910 barrels. During the year all cement was purchased in sacks, of which 33,475,408 were received and 29,882,968 were returned to the United States; of those returned, 269,775 sacks were rejected, or less than 1 per cent of those returned. The consumption of lumber was approximately 27,000,000 feet board measure, about the same as the preceding year, and the total receipts of lumber since the inception of the work have been 231,000,000 feet board measure. The stock on hand at all storehouses on June 30 amounted to \$3,436,995, a decrease of \$284,217 from the stock on hand June 30, 1912. The actual reduction was greater than the net decrease would indicate, as approximately \$638,000 worth of material was returned to stock by the various divisions. The problem of supply was especially difficult during the year. As the work draws to completion it is considered advisable to keep the stock on hand at as low a figure as possible and operate on a close margin. This necessitates sending a large number of rush and cable orders, increasing the work of the supply department on the Isthmus and of the purchasing agency in the United States. It is hoped that the spare parts now in stock can be worked off, particularly car, steam shovel, and locomotive repair parts, before final completion of the work.

Under the contract for the sale and removal of the French scrap on the Isthmus, entered into in September, 1911, 21,730 tons were collected from points along the line and shipped to the storage yard at Cristobal. The purchase price was \$215,000. The time allotted for the removal of the material was three years; almost two years have elapsed and the commission has received but \$13,473. A contract was entered into with the Chicago House Wrecking Co. covering all American iron and steel scrap already accumulated or that would accumulate during the fiscal year. This scrap totaled 12,109 tons. Payment was to be made on ship's bill of lading as shipped from the Isthmus; the commission has received only \$18,571, as but 2,466 tons have been shipped. The sale of scrap screenings removed from buildings netted \$6,866 and scrap rope\* and hose were sold to the value of \$4,693. Approximately \$75,000 were realized from the sale of copper and brass scrap that had accumulated in the operation of the Gorgona brass foundry.

Besides the regular issues to departments and divisions of the commission and the Panama Railroad a number of sales were made to employees, contractors, private individuals, and companies, the total amount aggregating \$106,037.77. The value of stock on hand at the obsolete storehouse on June 30 was \$431,916, an increase of \$70,000 over the total on hand at the close of the previous fiscal year. Invitations for bids were issued offering for sale a large amount of material in the obsolete storehouse on February 23, 1912; of the 24 classes advertised awards were made on but 6, as either no bids were received on the other classes or the bids were below the upset price of the material. Under the circular issued on February 1, 1913, satisfactory bids were received on only four of the 27 classes advertised. Results from these sales demonstrate that this method of sale of the entire equipment and material is not satisfactory. Firms or contractors desiring material buy only when they need it, and their necessities may not coincide with the particular time when advertisement is made, so that only the scrap dealer or middleman is benefited. It is believed that best results would be obtained by placing a fair upset price on such material and equipment and selling it when opportunity offers. A board of appraisal was appointed to place values on all articles that may be offered for sale. Under this arrangement equipment to the value of \$32,000 was sold and paid for. In addition, \$18,670 worth of equipment so appraised was sold to the United Fruit Co. in June, 1913, but delivery has not yet been effected.

The quartermaster's department attends to all purchases on the Isthmus, and the amount expended aggregated \$2,733,867, of which \$1,492,322.52 were for the purchase of coal from the Panama Railroad Co., \$995,408.92 for the purchase of crude oil from the Union Oil Co., and \$223,208.26 for miscellaneous purchases from the Panama



Railroad Co., leaving \$22,672.81 for the purchase of miscellaneous supplies from local merchants. The balance was used for postage stamps.

The work done for the sanitary department, consisting of grass and brush cutting, disposal of night soil and garbage, continued as heretofore. All grass was cut on request from the sanitary department. The total amount cut was 7,356 acres, of which 4,822 acres were cut by scythe, at an average cost of \$9.05 per acre, and 2,534 acres by horse mower, at an average cost of \$1.77 per acre. The area covered by this sanitary work was approximately 2,980 acres. The cost of the sanitary work done by the quartermaster's department amounted to \$125,983.21.

The supply of animal transportation was inadequate to meet the demands, and 50 mules were purchased at a cost of \$10,562, reaching the Isthmus May 26. These scarcely replaced the animals which were condemned or which died during the year. Six horses and 20 mules were condemned and destroyed and 5 horses and 4 mules died, a total of 35 animals.

For further information concerning the operations of this department attention is invited to Appendix J.

#### SUBSISTENCE DEPARTMENT.

The subsistence department is charged with the operation of the Isthmian Canal Commission hotels, messes, and kitchens, and is in charge of Lieut. Col. Eugene T. Wilson, United States Army, as subsistence officer.

On June 30, 1913, the department was operating the Hotel Tivoli, 17 line hotels, 3 night restaurants, 15 European laborers' messes, and 16 common laborers' kitchens—a decrease of 2 hotels, 3 messes, and 2 kitchens from last year. The hotel at Balboa was closed on July 16 and consolidated with the one at East Balboa. The hotel near the spillway at Gatun was closed March 31, and the messes at Cerro, Haut Obispo, Gatun (No. 68), and Naos Island were closed during the year, and one at Bas Obispo opened. A new kitchen was also opened at Bas Obispo, while those at Ancon, Cerro, and Haut Obispo were closed. The total revenue from the line hotels, restaurants, messes, and kitchens was \$1,235,077.84, a decrease of \$28,791.97 from last year, while the total cost of operations was \$1,205,800.76, a decrease of \$20,551.40, making the profit \$29,277.08, a decrease of \$8,240.57 from that of last year. The total number of meals served in line hotels was 2,340,644, an increase of 265,309 over last year. The total number of rations served in European laborers' messes was 935,516, or 172,659 less than last year. The total number of rations served in common laborers' kitchens was 461,456, a decrease from

last year of 123,001. The net expense for salaries and wages was \$166,398.65, an increase of \$4,391.88 as compared with the previous fiscal year. As the result of the year's operations the line hotels and restaurants showed a loss of \$3,837.71, an increase of \$8,247.66 over last year; European laborers' messes showed a profit of \$26,845.24, a decrease of \$11,610.54, and common laborers' kitchens showed a profit of \$6,269.55, a decrease of \$4,877.69.

A laundry was installed in the Hotel Tivoli to handle guests' work, and was opened in December, 1912. The hotel was operated at a profit of \$76,256.55.

For further particulars concerning the operation of the subsistence department attention is invited to Appendix K.

### EXAMINATION OF ACCOUNTS AND DISBURSEMENTS.

#### EXAMINATION OF ACCOUNTS.

The duties of the examiner of accounts were outlined in detail in the annual report of 1909 and continued with but little change during the year just ended. The department is in charge of Mr. H. A. A. Smith.

In the legislative, executive, and judicial appropriation act approved August 23, 1912, a provision was inserted relative to the administrative examination of public accounts and stated that "disbursing officers shall make only such examination of vouchers as may be necessary to ascertain whether they represent legal claims against the United States." After discussing the meaning of this provision with the Committee on Appropriations of the House, instructions were issued, effective May 1, 1913, by which the greater part of the detail check made by the disbursing officer of every voucher, pay roll and pay receipt was discontinued, and the responsibility formerly carried by the clerks of the disbursing office for such check was transferred to the clerks in the pay roll and voucher division of the examiner of accounts' office.

Effective January 1, 1913, the timekeeping division was organized by consolidating the work of preparing time and pay rolls for various departments and divisions, and continued under this department until July 1, 1913, when, with the approval of the Secretary of War, it was transferred to the fourth division of the chief engineer's office.

The only change made in the accounting system during the year was the extension of the classified expenditure accounts to provide for new operations, including the construction of new buildings, the electric transmission line, and clearing the lake, and a further separation of the accounts for the construction and maintenance of water-works and sewers to care for the permanent water supply. The material and supply account was closed at the end of the year and a

new account opened which is designed to provide a more exact record of material and supplies on hand and issued. The continuance of the method of absorbing plant and equipment charges resulted in distributing plant charges to the amount of \$27,550,635.24 to the construction divisions to June 30, 1913, leaving a balance to be absorbed on that date of \$1,941,488.61. As far as appeared practicable, cash payments for materials and supplies furnished and services rendered was adopted during the year. The work involved in the collection of money due the commission from employees and others was considerably reduced and the liability of loss due to giving credit was removed.

Under the agreement with the Republic of Panama for reimbursing the United States for expenditures incurred in connection with the construction and maintenance of waterworks, sewers, and pavements in the cities of Panama and Colon, the total amount expended in the city of Panama was \$1,626,267.58, and in the city of Colon \$1,550,030.46, or a total of \$3,176,298.04, including accrued interest to date at the rate of 2 per cent per annum. This interest has aggregated \$270,733.72. At the close of the fiscal year \$975,439.71 has been reimbursed. Included in this amount is \$32,785.01, representing the value of water used by the commission in the two cities.

The duty of purchasing and issuing commissary coupon books was transferred to the Panama Railroad Co., but, as the method continued of issuing coupon books to employees of the commission and making collections therefor by deductions on the pay roll, the work of the department was reduced but little; 60,790 hotel books and 1,363,100 meal tickets were issued, for which collections were made on the pay rolls. In addition, \$3,235,122 worth of commissary books were issued and collected on the pay rolls.

The administrative examination of the disbursing officer's accounts was made monthly, and the periodical examination of all fiscal officers' records of financial transactions and the auditing of their accounts were continued, involving a complete check of the records and cash and cash values in the hands of over 200 financially responsible officers. There were passed to the disbursing officer for payment audited vouchers amounting to \$9,022,000 and pay rolls amounting to approximately \$20,700,000. At the close of business on June 30 there were unaudited claims on hand amounting to \$57,197, the greater portion of which were in favor of the Panama Railroad Co. The force assigned to the inspection of time books and the work of timekeepers in the field was reduced, due partly to reduction in operations at certain points and partly to cooperation between departments and divisions. A few cases of padded time books were discovered toward the end of the year and five or six negro timekeepers, foremen, and laborers were convicted.

Under the provisions of the injury compensation act of May 30, 1908, as amended by section 5 of the act of March 4, 1911, 1,809 claims for compensation on account of injuries received in the course of employment were filed during the year, and 41 claims were filed on account of deaths—a total of 1,850; of these, 1,452 claims for injuries were allowed, and 130 were disallowed for the reason that the employees claiming compensation were incapacitated for less than 15 days, in which cases payments were made as meritorious sick leave under the act of February 24, 1909; in addition to these, 185 claims, including 25 claims pending from the previous year, were disallowed for some one of the following reasons: On account of negligence and misconduct of the employees; because the employees were not in course of employment, or not employees of the commission; because the accident described was not the cause of incapacity; because of lack of sufficient evidence to establish connection between the alleged injury and the incapacity; and because of failure to secure proper medical treatment. Of the death claims 21 were allowed, while 8 were disallowed for the reason that in 6 of them the claimants were not considered dependent parents within the meaning of the act, and in 2 of them death was due to negligence. Under the act of February 24, 1909, authorizing meritorious sick leave to injured employees for not exceeding 30 days in any one year, 4,715 cases were allowed. The average duration of disability of cases for which injury compensation claims were filed was 58 days, whereas in meritorious sick leave cases the average duration was 5 days. The total amount expended during the year in settlement of these claims was \$224,071.72, making a total from August 1, 1909, to June 30, 1913, of \$915,824.79.

Congress has appropriated a total of \$349,505,223.14 for canal construction, including appropriations contained in the act of June 23, 1913. Of this amount, \$10,676,950 were for fortifications, of which \$4,870,000 were appropriated by the act of June 23, 1913, and \$21,411.56 were for the relief of private persons. The balance, \$338,806,861.58, including \$16,265,393 appropriated by the act of June 23, 1913, was appropriated for the construction of the canal and is a charge against the total authorized bond issue of \$375,200,900. This leaves available for appropriation a balance of \$36,394,038.42. The actual cash balance on hand June 30, 1913, for the construction of the canal, excluding the amount available for fortifications, was \$20,673,904.79. Up to June 30, 1913, \$5,856,838.35 were collected and returned to the Treasury as miscellaneous receipts. This item represents the total amount appropriated by Congress which, after being used for miscellaneous purposes in connection with the canal work, was covered back into the Treasury and lost to canal appropriations.

The examiner of accounts is also auditor for the Canal Zone government. He receives, examines, and settles all accounts pertaining

to the revenues of the Canal Zone government and expenditures therefrom. The amount of revenues derived from rentals and taxation decreased from \$259,759.68 in 1912 to \$212,266.83 in 1913. The disbursement of Canal Zone revenues increased from \$214,000 in 1912 to \$233,000 in 1913, the increase being principally due to sanitary work in native villages and increased expenditure for maintenance of Canal Zone roads and trails.

For further particulars, attention is invited to Appendix L.

#### DISBURSEMENTS.

The work of this department embraces the securing of and disbursing the necessary funds and the accounting for all moneys paid out or collected, as well as the issuance of hotel and commissary books and meal tickets to the various departments of the commission. It was in charge of Mr. E. J. Williams, disbursing officer.

The total amount paid out by the disbursing officer on pay rolls aggregated \$20,524,705.75, in addition to which \$9,035,630.18 were paid out in settlement of public bills and on reimbursement vouchers. The value of hotel books, commissary books, and meal tickets issued totaled \$1,305,405.

For further details, attention is invited to Appendix M.

#### DEPARTMENTS OF CIVIL ADMINISTRATION AND LAW.

##### CIVIL ADMINISTRATION.

The organization of the department of civil administration remained substantially as described in former annual reports and continued in charge of Mr. Maurice H. Thatcher until June 14, 1913, when he entered on leave of absence, at the expiration of which his services were terminated by resignation.

Seven acts of Congress and four joint resolutions affecting the Panama Canal and the Canal Zone were enacted during the year, the most important being the Panama Canal act, approved August 24, 1912, providing for the opening, maintenance, protection, and operation of the Panama Canal and the sanitation and government of the Canal Zone. Four ordinances were enacted by the Isthmian Canal Commission and approved by the Secretary of War, the most important of which amended certain of the rules governing the navigation of the Panama Canal and the approaches thereto. At a meeting of the commission held April 24, 1913, a resolution was adopted that no further licenses be granted for the sale of intoxicating liquors on the Canal Zone.

Negotiations carried on with the officials of the Republic of Panama included the following subjects: Arrest by Panamanian police of commission employees while engaged in the performance of their

duties in the cities of Colon and Panama; the reciprocal licensing of carts and wagons used in the transportation of merchandise in the Republic and the Canal Zone; municipal and sanitary improvements in Colon and Panama; the superior right of the United States under the treaty to use the rivers and streams of the Republic; the deportation to the Republic of ex-convicts who have served terms of imprisonment in the Canal Zone; the admission of merchandise shipments consigned to the commission, the Marine Corps, the Tenth Infantry, and the wireless stations, without the intervention of Panamanian customs officials; delay in customs release covering shipments consigned to commission and Panama Railroad employees; collection of customs duties on parcel-post packages coming through the post offices of the Canal Zone; establishment of a uniform schedule of rates to be charged for transporting passengers by automobile between points in the Canal Zone and the cities of Colon and Panama; the collection of a tax by Panama upon steamship tickets covering passage to foreign ports; and the tax upon steamship agencies doing business in the Canal Zone and in the Republic of Panama. The relations of the commission with the Republic of Panama and with foreign representatives continued satisfactory.

During the year the board of local inspectors issued 88 licenses to pilots; 41 to masters, 19 of which were issued as joint master-pilot licenses; 22 to mates; and 58 to engineers—a total of 209 licenses. Under the provisions of the Executive order of July 21, 1911, certificates were issued to 94 vessels, of which 18 were over 100 gross tons burden. One hundred and sixty-two licenses as navigators of motor boats were granted. Licenses were also issued to 120 chauffeurs.

Postage sales for the fiscal year amounted to \$100,804.38, an increase of \$13,109.97 over the previous year. There were 160,742 registered letters and parcels handled, of which 41 per cent was official matter. Money orders to the number of 238,316, having a total value of \$4,883,624.13, were issued, on which the fees amounted to \$23,347.12. Of the money orders issued during the year, orders amounting to \$3,917,899.30 were made payable without and \$965,724.83 within the limits of the Canal Zone. At the close of the fiscal year there was on deposit in the postal savings banks a total of \$645,690. There were in the post offices of the Canal Zone on the same date unpaid money orders aggregating \$156,928, drawn to the order of the remitters and payable at the offices of issue.

During the year 281 vessels entered the port of Ancon, with a total tonnage of 553,767, and 283 vessels cleared, with a total tonnage of 556,306. At Cristobal 280 vessels entered, with a tonnage of 849,702, and 283 vessels cleared, with a tonnage of 858,703.

On June 30, 1913, there were in force 319 leases, of which 312 were for building lots, 1 for land, and 6 for buildings. Rents collected

during the year amounted to \$4,792.95. A total of \$53,855.95 was collected from general taxes and licenses; of this amount, \$9,130.55 were for distillation taxes, \$43,800 for licenses for the sale of liquor at retail, \$1,180.38 for license fees from insurance companies doing business in the Canal Zone, and \$2,240.50 for licenses for motor vehicles.

During the year 470 estates were settled, and on June 30, 1913, there were 78 estates in the course of settlement. The money handled on account of the administration of estates was \$30,124.24.

A reorganization of the division of police and prisons was effected on September 1, 1912, as a result of which the authorized strength of the force was reduced from 274 to 247. There were 6,827 arrests made, of which number 6,079 were males and 748 females. Of the total number of persons arrested 77 per cent were convicted. On June 30, 1913, there were 133 convicts confined in the penitentiary; practically all of these were kept at work on the public roads, and the value of their work was \$26,561.75. The cost of guarding, subsisting, and clothing the convicts was \$30,178.23. The stockade on the Mandingo River was closed during the year and all convicts were transferred to a new stockade erected near Gamboa bridge; the prisoners will be housed here during the construction of the wagon road leading from Gamboa to connect with the Panama-Empire Road.

Although no change was made in the authorized strength of the division of fire protection, there was actually a reduction of 15 men as compared with the number in service at the close of the previous year; the reduction was made necessary by a cut in the appropriations for the department. Purchase of two automobile fire engines, mentioned in the last annual report, made possible the discontinuance of the one-man stations at Balboa and Mount Hope, the consolidation of the two Ancon stations, and the sale of six fire horses. All fire equipment installed in the buildings at Gorgona was removed upon the abandonment of that settlement and most of it has been installed in the buildings reconstructed at Corozal and Balboa. There were 220 alarms of fire responded to, 18 of which were false. Of the 202 fires, 1 was in the city of Panama and 7 in the city of Colon; 104 were in Government property and 20 in property of the Panama Railroad Co. The value of Government and railroad property involved was reported to be \$834,077.44; the total loss was estimated at \$12,173.77 for Government property and \$501.75 for the property of the Panama Railroad Co. The largest and most serious fire in the Canal Zone occurred at Toro Point, causing a loss to the commission of \$11,326.98. The year's fires resulted in five injuries from burns; no loss of life occurred.

The authorized organization of the division of public works remained unchanged throughout the year, although the deficiency in the department's appropriations made it necessary to dispense with two inspectors. All municipal improvements in the city of Panama undertaken under the appropriation of \$800,000 which were completed were turned over to this division for maintenance. On June 30, 1913, 2,101 water connections had been made in the city of Panama and on that date 22 applications were pending. The collections of water rents from private consumers for the first three quarters of the year in the city of Panama were \$81,727.75, and bills rendered for the last quarter aggregated \$32,583.75. For the first three quarters of the year the water collections exceeded requirements by \$13,219.69, which was applied to the reduction of the cost of waterworks, sewers, and pavements. In the city of Colon 866 connections had been made with water mains and on that date there were 55 applications pending. Collections in Colon from private consumers and from the commission and Panama Railroad Co. during the first three quarters amounted to \$64,058.15, and the net amount of bills rendered for the fourth quarter was \$24,168.80. For the city of Colon the Republic of Panama paid \$9,675.05 in order to liquidate its proportionate share of the cost of water, sewer, and street systems for the first three quarters of the fiscal year. In the Canal Zone 695 water connections have been made. From the eight public markets in operation during the year a revenue of \$3,805.50 was derived in rent.

The organization of the division of schools consisted of 1 superintendent, 1 supervisor of upper grades and high schools, 1 supervisor of primary grades, 2 clerks, 2 supervisors of children, 1 principal of high school, 6 principals of grammar schools, and 72 teachers. The school year opened October 1, 1912, with an enrollment of 2,199 children—1,157 whites and 1,042 blacks. At the close of the fiscal year 29 school buildings were in use—14 for whites and 15 for blacks. Medical inspection of all pupils was continued and 1,044 pupils were treated during the school year.

The supreme court held 26 sessions during the year. It affirmed decisions of the circuit courts in two and reversed the decisions of those courts in two criminal cases. At the beginning of the year two civil cases were pending in the supreme court, 22 were filed, and 18 were disposed of. In the circuit courts, 533 criminal cases were instituted, out of which number there were 369 convictions, 93 acquittals, and 67 dismissals, leaving 4 cases pending at the close of the year. There were 585 civil actions brought, 750 of which were settled and 108 pending on June 30, 1913.



At the beginning of the fiscal year there were \$259,102.16 in the Zone Treasury, and during the year collections amounted to \$336,603.33. Expenditures for the year totaled \$374,868.04.

For further particulars concerning the work of this department, attention is invited to Appendix N.

#### DEPARTMENT OF LAW.

The department continued in charge of Judge Frank Feuille and the duties are as outlined in previous annual reports.

In anticipation of the inundation of the Gatun Lake area, a number of towns along the line of the old Panama Railroad between Gorgona and Gatun were cleared of their population; as a result, the administrative district of Gorgona was abolished and its territory added to the district of Empire for judicial, administrative, and political purposes, by an Executive order issued September 2, 1912. The order also abolished the office of senior district judge and reduced the number of district judges to 3.

The Panama Canal act, approved August 24, 1912, authorized the President to declare that all land and land under water within the limits of the Canal Zone are necessary for the construction, maintenance, operation, sanitation, and protection of the Panama Canal. Pursuant to these provisions an Executive order was issued under date of December 5, 1912, directing that all land and land under water within the limits of the Canal Zone be taken possession of on behalf of the United States and to extinguish, by agreement when practicable, all claims and titles of adverse claimants to the occupancy of land and land under water. Due to the additional work that was thrown upon the department by reason of this order, and also for the purpose of representing the United States before the joint land commission which had been appointed in compliance with the provisions of the treaty, the personnel of the department was increased by one clerk and a land inspector during the latter part of the fiscal year. As negotiations have been pending between the United States and the Republic of Panama for the exchange of lands known as Las Sabanas, lying contiguous to the city of Panama, in the Canal Zone, for certain harbor areas in the city of Colon, an Executive order of February 18, 1913, was issued, modifying the provisions of the Executive order of December 5, 1912, exempting privately owned lands in the territory under negotiation from being acquired by the United States. On March 19, 1913, an Executive order was issued protecting from wanton killing or injury the birds of the Canal Zone. By Executive order of March 20, 1913, amending the Executive order of February 5, 1912, the collector of revenues was authorized to administer upon estates which consisted of personal property only,

regardless of the value of the estates, the maximum value previously fixed being \$1,000. Under existing law, therefore, the estates of deceased or insane employees of the Canal Commission, the Canal Zone government, and the Panama Railroad Co. are administered by the collector of revenues free of cost. The actions of the collector are subject to the supervision and approval of the Circuit Court of the First Judicial Circuit of the Canal Zone.

Complaints had been made from time to time that the agents of foreign corporations whose financial condition was doubtful were doing business in the Canal Zone, to the exploitation of our employees. To prevent this as far as possible an Executive order was issued on March 20, 1913, requiring foreign corporations or joint stock companies to file their articles of incorporation with the collector of revenues for the Canal Zone, together with such information as will enable the collector of revenues to base a conclusion as to the solvency of the concern. In addition to this, foreign corporations are required to file authorization with the collector of revenues to represent them in all suits and legal proceedings in the Canal Zone, and to pay an annual tax of \$50. The order has had a salutary effect in keeping out undesirable concerns.

On April 15, 1913, maritime quarantine regulations for the Canal Zone and the harbors of the cities of Panama and Colon in the Republic of Panama were established by Executive order, the regulations to take effect upon the date on which the Panama Canal is officially and formally opened for use and operation by proclamation of the President of the United States. The regulations were promulgated in advance in order that shipping interests and the traveling public may have information in regard to the quarantine requirements of the canal and the Canal Zone.

Due to the fact that the prosecuting attorney devoted his time almost exclusively to the adjustment of land claims, especially those coming before the joint land commission, the prosecution of all criminal cases was conducted by the assistant prosecuting attorney and 621 criminal cases were disposed of in the three circuits; of the total number of defendants tried, 449 were convicted, 111 were acquitted, the charges against 54 were dismissed, and in 7 cases the defendants are fugitives from justice. One disbarment proceeding was brought in the supreme court against an attorney of the Canal Zone, and the defendant was disbarred from practice in the Zone courts.

A total of \$27,606.50 was paid by the commission in settlement of claims presented by squatters and occupants of Zone lands. Several tracts of land were acquired from private persons by deed. In addition to the above, quitclaim deeds were obtained for the United States for holdings at Santa Isabel, El Encanto, Victoriano, and Paja. On

March 31, 1913, all unexpired Canal Commission leases for building lots and agricultural property were terminated; on that date there were 174 leases, covering 99 hectares of agricultural land and 108 building lots, which would have remained in force until June 30, 1913, had it not been for the order of cancellation.

Revocable licenses to the number of 312, covering 347 building lots, were in force on June 30, 1913, calling for an annual rental of \$2,816.96.

For further details concerning this department, attention is invited to Appendix O.

#### DEPARTMENT OF SANITATION.

This department has charge of sanitary work in the cities of Colon and Panama and of oiling ditches and other water in the Canal Zone. It designates the remaining sanitary work to be done in the Canal Zone and exercises such supervision as may be necessary to insure proper performance of the work. In addition, the department has charge of the hospitals and quarantine. It is in charge of Col. William C. Gorgas, United States Army, as chief sanitary officer.

The work in the terminal cities consists in cutting grass and brush, oiling pools, constructing and maintaining ditches for drainage purposes, removal of garbage and night soil, fumigation, and street cleaning. On account of the juxtaposition of Cristobal, Mount Hope, and Toro Point to Colon these are included in the Colon area, and for the same reason Ancon Hospital grounds are included with Panama. According to the report submitted, the work done in Panama consisted in cleaning 200 miles of ditches, digging 1.2 miles of ditches, and clearing 114 acres of weeds and grass, in addition to filling and cleaning cesspools and wells, oiling, disinfecting, and fumigating. In the Colon district, from the same source, 72 miles of ditches were maintained, 77 miles of ditches were constructed, and 29 acres were cleared of vegetation, in addition to oiling, disinfecting, and fumigating.

The total expense for sanitary work in the Canal Zone and in the cities of Panama and Colon was \$510,529.17, of which \$62,955.06 was for sanitation proper in the two cities, \$371,844.90 for sanitation proper in the Zone, \$10,627.60 for removal of garbage and street cleaning in the two cities, and \$65,101.61 for removal of garbage and street cleaning in the Zone. Of the amount expended for sanitation proper in the Zone the construction divisions expended \$91,877.98, principally in the maintenance of existing ditches and the construction of new ones for drainage purposes; the quartermaster's department, \$50,533.13 for grass and brush cutting. The sanitary department used in the Zone 674,662 gallons of oil, costing \$17,669.69, and 120,992 gallons of larvacide, costing \$21,759.96; the labor expense

for distributing was \$21,320.39 and \$19,567.39, respectively. All work performed by the construction divisions and the quartermaster's department was done under the direction of the sanitary department. The removal of garbage and night soil in the Zone was done by the quartermaster's department.

Admissions to hospitals and sick camps during the year, including those sick in quarters, totaled 33,779; the daily average number of employees sick was 19.04 out of every thousand, as against 22.91 for 1911-12 and 24.77 for 1910-11—this on the basis that the total numbers employed during the years mentioned were 54,000, 50,008, and 49,129, respectively. The total number of deaths among employees was 483, of which 36 were Americans, 58 were white employees of other nationalities, and 389 were blacks. The total number of deaths from violence among all employees was 164, as against 154 for the preceding year. In addition, on the recommendation of the medical examining board, 183 deportations were made—134 for disease and 49 on account of injuries.

For further details concerning this department attention is invited to Appendix P.

#### RECREATION OF EMPLOYEES.

On June 30, 1913, clubhouses were in operation at Corozal, Empire, Gorgona, Gatun, and Cristobal in the Canal Zone, and at Porto Bello, about 20 miles down the Atlantic coast.

The clubhouse at Culebra was removed because of slides and a portion of the building was reerected at the rear of the administration building annex at a cost of about \$1,700, paid from clubhouse funds. Bowling alleys, pool and billiard tables, soda fountain, barber shop, and a reading room were thus provided in this new location. Entertainments were given in the second story of the schoolhouse.

The average monthly membership for the year was 2,023, as against 1,944 for the previous year. The largest membership for any given month was 2,127, the largest since organization.

The total expenditures from commission funds for the support of these clubhouses aggregated \$49,925.96.

For further details concerning the operation of the clubhouses, see Appendix Q.

#### WASHINGTON OFFICE.

The work of the Washington office continued in charge of Maj. F. C. Boggs, United States Army. The scope of the work was as previously reported, but was made more difficult and arduous by the fact that, in the desire to reduce the amount of stock on hand, the number of rush orders was increased.

During the year 2,065 persons within the United States were tendered employment for duty on the Isthmus in grades above that of laborer; 1,183 accepted and were appointed, covering 59 different positions.

The total amount of purchase orders placed for the fiscal year was \$12,335,973.12. The most important contracts were for permanent equipment: For structural material for locks and spillways, \$241,326.33; machinery for their operation, \$740,302.02; electric locomotives and tracks, \$548,732.67; hydroelectric station, \$72,540.34; dock material, \$571,723.48; shop buildings and machinery, \$593,649.51; transmission line, \$688,503.38; and two 250-ton revolving floating cranes, \$837,500. Other principal items of purchase included two 15-yard dipper dredges, 6,310,000 pounds of dynamite, and 23,505,695 feet of lumber. A supplemental contract was entered into September 13, 1912, covering the additional quantity of cement necessary to complete the work. During the year 1,303,762 barrels of cement were purchased.

For further details, attention is invited to Appendix R.

#### GENERAL REMARKS.

Since the submission of the last annual report the concrete work of the locks has been completed, and but for slides which developed excavation in the central division would also have been finished. In the last annual report the completion of the canal by the close of the fiscal year was predicated on the completion of the lock gates by the contractor and the slides. As already noted, the contract for the completion of the gates has been extended and contemplates finishing up all work on one flight throughout by October 1, 1913. Work on the installation of the operating machinery was concentrated so as to meet this condition of the lock gates, and it is believed that one flight of locks throughout will be ready for operation October 1, 1913, except the fender chains and the control houses, but electrical current from existing power plants will be usable until the completion of the hydroelectric station. Assuming the lake level at elevation 50, July 1, with an average rainy season the lake should reach elevation 85 by December 1, 1913. The rainfall during the month of May was excessive and above the average; the rainfall during July was below the average, so that the lake has not reached the elevation that it should have at this time by about  $3\frac{1}{2}$  feet.

The slides which occurred to prevent completion of the Cut as anticipated a year ago are at Cucaracha, the east side opposite Culebra, two in the vicinity of the Empire suspension bridge, relatively small, and one opposite Whitehouse. With the exception of the Cucaracha slide, these could probably be removed in the dry by January 1, 1914, but the removal of Cucaracha slide in the dry would require

until April, 1914. The material can not be handled expeditiously by steam shovels during the wet season, but lends itself to economical removal by hydraulic dredges. Except at Cucaracha, the existing channel by the slides is to full depth and of a width of at least 200 feet at the bottom. Assuming that all the slides were removed by steam shovels in the dry, the water in the lake could not be raised above elevation 60 and still be kept out of the Cut by the dike at Gamboa, so that after the advent of the dry season it would not be possible, under normal conditions, to secure full lake level until October or November, 1914. The material in all the slides can be handled advantageously by the dredging fleet augmented as it will be later by the two 15-yard dipper dredges under contract. They will operate against banks in every case and will not be excavating for the full depth of 45 feet. The sea level sections by the time the dredges can be moved into the Cut will be in condition for the passage of ships of the heaviest draft.

It has been the general belief that the effect of the water in the Cut would tend to retard slides and the experience below the Gatun locks in the sustaining power of water against slides fully justifies this belief; on the other hand, the geologist is of the opinion that the water may to some extent develop new slides. Again, much ado was made in 1909 over the seamy character of rock on the Isthmus, through which water flows quite rapidly, in consequence of which the question was raised that the lake might leak out through seams and crevices. If these things are liable to occur, the sooner the better, if the official opening of the canal is to occur January 1, 1915; for if water were not admitted this fall but were deferred until May 1, 1914, the full height could not be reached until October, 1914, leaving little time for the determination of these questions. These considerations led to the conclusion that the water should be turned into the Cut at the earliest date practicable for getting the dredges to work on the slides. Dredges can be passed through into the Cut as soon as the lock gates of one flight are completed, and this is reasonably certain to be the case by October 1. With the average rainfall, the lake should reach elevation approximately 70 by October 10, and a greater height of water against the dike which excludes the lake from the Cut at present would not be safe. The present plans, therefore, are based upon the blowing up of Gamboa Diike on October 10, its removal by dredges immediately thereafter, the transfer of two suction dredges and the ladder dredge *Corozal* to the Cucaracha slide, the smaller dipper dredges to work on the other slides until the full width of the channel is attained, and the passage of vessels through the canal as soon as channels of full depth and of sufficient width have been secured.

An erroneous impression has been caused by the announcement that the water will be turned into the Cut October 10, as it seems to have been assumed that the canal will be practically finished on that date. Before boats can be passed it will be necessary to remove the Gamboa dike by dredges and to remove the slides as already outlined. The passage of commercial vessels is dependent, therefore, upon the time when proper channels can be dredged through the slides; should additional ones occur, they will necessarily advance the date when this will be accomplished.

The following appendixes are herewith:

Report of the geologist, Appendix S.

Increase in salaries and increase in numbers of employees, submitted in compliance with law, Appendix T.

Laws affecting the canal recently enacted, and executive orders issued during the fiscal year, Appendix U.

The organization in effect July 1, 1913, Appendix V.

Respectfully submitted.

GEO. W. GOETHALS,  
*Colonel, Corps of Engineers, United States Army,*  
*Chairman and Chief Engineer.*

THE HON. LINDLEY M. GARRISON,  
*Secretary of War, Washington, D. C.*





## APPENDIX A.

### REPORT OF COL. H. F. HODGES, CORPS OF ENGINEERS, UNITED STATES ARMY, MEMBER OF ISTHMIAN CANAL COMMISSION, ASSISTANT CHIEF ENGINEER, IN CHARGE OF THE FIRST DIVISION OF THE OFFICE OF THE CHIEF ENGINEER.

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ISTHMIAN CANAL COMMISSION,  
OFFICE OF THE CHIEF ENGINEER, FIRST DIVISION,  
*Culebra, Canal Zone, July 22, 1913.*

SIR: I have the honor to make the following report of operations during the fiscal year ending June 30, 1913, of the first division of the office of the chief engineer:

The division is charged with the design of locks, dams, regulating works, and accessories; with the design and construction of aids to navigation; with the erection of the operating machinery at the locks and spillways; and of the power transmission line. In addition, it is responsible for the inspection of the manufacture and for the erection, under contract or otherwise, of certain of the structures and machines designed in its different subdivisions.

During the fiscal year the division has been organized in subdivisions in charge of designs and work as follows: (*a*) Design of masonry and lock structures, including spillways and valves; (*b*) design of lock gates and protective devices, including the inspection of construction and of erection under contract; (*c*) design of operating machinery and electrical installation, including inspection and erection; (*d*) design of movable dams, including inspection of construction and of erection under contract; and (*e*) design and construction of aids to navigation. On June 30, 1913, the subdivision having charge of the masonry and lock structures was discontinued, its work having been completed.

A chart of the approved organization is herewith (plate No. 126.)

#### MASONRY AND LOCK STRUCTURES.

This subdivision has been under charge of Mr. L. D. Cornish, designing engineer, assisted by Mr. T. E. L. Lipsey, assistant engineer, and the necessary draftsmen, and for part of the time by Messrs. L. B. Fay and F. J. Severy, assistant engineers.

#### LOCKS.

At the end of the fiscal year 1912 the general designs for all the locks, including both upper and lower approach and wing walls at Gatun, Pedro Miguel, and Miraflores, also practically all the detailed plans for all the locks, including decking drawings showing details of

construction over rising stem gate valve machinery chambers, miter gate moving machinery chambers, intake valve machinery chambers, and other miscellaneous deckings had been adopted, approved, and issued. Practically all detailed drawings needed by the working force in the field had been made and issued from time to time.

During the fiscal year 1913 the following designs were finished: Track supports on the lower middle approach walls and upper and lower wing walls at Pedro Miguel and Miraflores; reenforced concrete piles under the above tracks, new north wing wall at Miraflores spillway; fenders for protection at upper and lower ends of middle approach walls at all locks; railings for upper approach and lower wing walls at Gatun and Miraflores spillways; doors for entrances to operating tunnels from top of lock walls; parapet walls around stair walls to operating tunnels; and miscellaneous designing for other subdivisions. The last item includes, among important features, certain work done for the second division of your office on the coaling plants at the canal terminals.

#### VALVES AND FIXED IRONS.

*Design and contract.*—At the end of the fiscal year 1912 the designs for the lock valves, fixed irons, and accessories had been completed and approved.

During the fiscal year 1913 the erection of this ironwork has been under the supervision of this subdivision.

At the instance of the second division of your office, designs were prepared for the valves of the dry dock at Balboa.

*Installation.*—At the end of the fiscal year 1912, 14 chambers (12 at Gatun and 2 at Pedro Miguel) had been prepared for the installation of valves, and 12 valves, including trains and sealing devices, had been placed in position in the locks at Gatun. Six bulkhead gates in side-wall intakes and six bulkhead gates in center-wall intakes had been placed at Gatun. Three rising-stem gate valves and one cylindrical valve had been placed in the spillway at Gatun. All cylindrical valves had been placed in the locks.

During the fiscal year 1913, 102 rising-stem valve chambers (50 at Gatun, 28 at Pedro Miguel, and 24 at Miraflores) were prepared, and 104 valves, including trains and sealing devices (48 at Gatun, 28 at Pedro Miguel, and 28 at Miraflores), were placed in position in locks. Six side-wall intake screens were placed at Gatun, four center-wall screens have been placed; the bulkheads to center-wall intakes have been removed, and the same have been placed in the outlet; the four lower side-wall bulkhead gates have been placed, all at Gatun.

#### FIXED IRONS FOR SPILLWAYS, SPILLWAY GATES, CAISSONS, FOOTBRIDGES, AND RAILINGS.

*Design and contract.*—At the end of the fiscal year 1912 the designs had been practically completed, and contracts had been let for this material.

During the fiscal year 1913 designs were made for additional railings for the spillways, and the erection of the ironwork has been under the supervision of this subdivision.

*Erection and installation.*—At the end of the fiscal year 1912 the work of erection had not been begun. During the fiscal year 1913 the entire number of 14 gates and 1 caisson for Gatun and 8 gates and 1 caisson for Miraflores have been erected complete and contract closed. The gates at Gatun have also been installed in position on the dam. The erection of the draft tubes for the hydroelectric station at Gatun has been completed, the inspection of the work having been under the supervision of this subdivision.

## DRAWINGS.

During the fiscal year 1911, 133 drawings were made, approved, and issued, covering the features hereinbefore mentioned. During the fiscal year 1912, 181 drawings were made, approved, and issued, and 10 new spillway drawings were made and issued; a drawing of Pedro Miguel Lock was made for the Post Office Department, and work was begun on final drawing of Pedro Miguel Lock for record. During the fiscal year ending June 30, 1913, about 87 drawings were made, approved, and issued. A drawing of Gatun Dam and Culebra Cut were made for the Post Office Department. Work on the final drawing of Pedro Miguel Lock was continued and is now about 75 per cent completed. Work on final drawing of Gatun Lock was begun, but very little was done.

*Summary of drawings.*

Spillway masonry plans.....	91
Spillway caissons, footbridges, railings, etc.....	20
Spillway gates, fixed irons, etc.....	7
Valves, fixed irons, and miscellaneous ironwork.....	79
Locks and details.....	305
Sketches.....	4
<hr/>	
Total.....	506

A number of sketches and designs for coaling docks at Balboa and Cristobal, permanent shops at Balboa, terminal docks at Cristobal, and valves for dry docks were made, also about 14 drawings covering valves.

## CONTRACTS.

During the fiscal year 1913, the following contracts have been completed:

Dated September 11, 1911, with the McClintic-Marshall Construction Co., of Pittsburgh, Pa., for 22 spillway gates, 2 steel caissons, and material for 22 footbridges, 132 rising-stem gate valves (2 spares), 12 guard-gate valves, 6 lateral culvert valves, 12 bulkhead gates to middle wall culverts, 27 bulkhead headgates at intakes, and 36 screens at intakes. Total contract price, \$342,681.88.

Dated September 2, 1911, with the Excelsior Tool & Machine Co., of East St. Louis, Ill., for 515 tons of fixed irons for spillways at Gatun and Miraflores. Total contract price, \$25,724.12.

Dated September 11, 1911, with the Westinghouse Machine Co., of Pittsburgh, Pa., for 264 roller trains (4 spares), 292 sealing devices (32 spares) for rising-stem gate valves in all locks, 46 roller trains (2 spares), 52 sealing devices (8 spares), rocker bearings and tracks for spillways at Gatun and Miraflores. Total contract price, \$177,147.58.

Dated August 21, 1911, with the Vulcan Rail & Construction Co., of Brooklyn, N. Y., for material required for 22 sets of railings for Gatun and Miraflores spillways. Total contract price, \$5,665.

Dated December 26, 1911, with the United States Steel Products Co., of 30 Church Street, New York, N. Y., for material for four intake bridges at upper end of Pedro Miguel and Miraflores Locks and structural material for deckings over rising stem gate valve machinery chambers and miter gate moving machinery chambers of all locks. Total cost, estimated, \$21,414.97.

Dated November 23, 1911, with the Standard Foundry Co., of 743 Hartel Avenue, Buffalo, N. Y., for snubbing posts and washers for all locks. Total contract price, \$5,518.09.

Dated November 23, 1911, with the American Car & Foundry Co., of 165 Broadway, New York, N. Y., for bolts, links, anchor rods, etc., for buffers on all lock walls. Total contract price, \$6,257.02.

Dated December 21, 1911, with the Railway Spring & Steel Co., of New York City, N. Y., for 25,608 helical springs for spring buffers on approach walls of locks. Total contract price, \$13,572.24.

Dated November 11, 1911, with J. B. Kendall Co., of Washington, D. C., for cold-twisted square steel bars for reenforcing deckings over miter gate moving machinery and rising stem gate valve machinery chambers for all locks. Total contract price, \$1,059.35.

Dated January 5, 1912, with the United States Steel Products Co., of 30 Church Street, New York, N. Y., for triangular mesh slab reenforcement for deckings over rising stem gate valve and miter gate moving machinery chambers for all locks. Total contract price, \$891.44.

Dated December 13, 1912, with the Carbolineum Wood Preserving Co., of New York, for carbolineum for treating the buffer timbers on all approach walls of locks. Total contract price, \$3,090.

Dated November 14, 1912, with W. R. Grace & Co., of New York, N. Y., for timbers for buffers on all the approach walls of locks. Total contract price, \$18,910.

During the fiscal year 1913 the following contracts were let and are still pending:

Dated May 21, 1913, with Oliver Iron & Steel Co., of Pittsburgh, Pa., for drift bolts for protection cribs at the ends of middle approach walls of all locks. Total contract price, \$3,660.91.

Dated May 19, 1913, with W. R. Grace & Co., of New York, for timber for protection cribs at ends of middle approach walls to all locks. Total contract price, \$41,456.79.

Dated April 26, 1913, with Vulcan Rail & Construction Co., of Brooklyn, N. Y., for railings for spillway dams at Gatun and Miraflores. Total contract price, \$3,312.

Dated May 23, 1913, with Mesker Bros. Iron Co., of St. Louis, Mo., for 99 steel galvanized doors for entrances to operating tunnels of all locks. Total contract price, \$4,398.

## CASTINGS MADE ON ISTHMUS.

In addition to the ironwork made in the United States, the commission's foundry has made or fabricated, in accordance with designs of this subdivision, amounts or weights as follows: Material furnished during fiscal year 1910-11, about 954 tons; material furnished during fiscal year 1911-12, about 4,407 tons; material furnished during fiscal year 1912-13, about 39 tons. Total tonnage to date, approximately, 5,400 tons.

## TESTS.

Tests of discharge were made on the cylindrical valve and the three rising stem gate valves in the spillway. The first series of observations, with heads varying from 8.94 to 29 feet above the center of the valve, gave values of the coefficient of discharge<sup>1</sup> for the cylindrical valve of 0.445 as the mean of three observations, and for the gate valves of 0.592 as the mean of six observations. The observations were complicated by the presence of screens in the culvert entrances, which gave free discharge when clear, but became clogged with drift and debris after being exposed to a continuous flow for some time. After this clogging the discharge decreased considerably. Later observations, made after the screens had been removed from the culvert entrances, gave a considerably increased coefficient of discharge for the rising stem valves. The average of the second series of 58 observations, with average head of 29.81 feet above the middle point of the valve, gave a value of coefficient of 0.680. This figure is undoubtedly reliable for the valves under the conditions in which they were operated in the spillway. It is probable that a somewhat less favorable value will be obtained in operating the lock culverts, on account of the friction and changes of direction in the stream after it passes the valve. The cylindrical valve was removed before the later and more reliable observations were recorded.

Upon discontinuance of this subdivision at the close of the fiscal year the unfinished part of its work, which is of minor importance, was divided among other subdivisions of the office.

## LOCK GATES AND PROTECTIVE DEVICES.

This subdivision has been under the immediate charge of Mr. Henry Goldmark, designing engineer, assisted in the office by Mr. Lewis A. Mason, assistant engineer, and the necessary draftsmen and clerk. The force organized for inspection of lock gates in the United States was under the immediate charge of Mr. Johannes Hammer, assistant engineer. The inspection of the chain fenders in the United States, was carried on by Mr. Jacob Soderberg, assistant engineer, until March 1, 1913, when it was turned over to Mr. Hammer. Mr. Frank Price assisted Mr. Hammer as chief inspector. On the Isthmus, Mr. George F. Guynn was the chief inspector for the erection of the lock gates, with Messrs. B. B. Dumville, C. H. Matthews, and William Howe as principal assistants, and Mr. E. H. Baughman was chief inspector on the chain fenders.

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<sup>1</sup> c in formula  $Q = A c \sqrt{2 g h}$

## LOCK GATES.

The construction and erection of the lock gates was continued during the fiscal year under the contract with the McClintic-Marshall Construction Co., dated June 21, 1910. All shop drawings had been completed previously, so that the office work in connection with the lock gates was confined to the preparation of some minor plans.

By the beginning of the fiscal year all the steel plates and shapes had been rolled, and 39,000 tons of structural steel parts, equivalent to 76 per cent of the total, had been fabricated at the contractors' works and shipped to the Isthmus, besides the necessary castings and minor parts.

During the present year the manufacture of all material for the gates (aggregating 57,500 tons) was completed, the final shipment being made in April.

In addition to this, about 2,100 tons of structural work for the spare parts were built and delivered on the Isthmus, completing this part of the contract with the exception of a few castings, bolts, and rivets.

The spare parts comprise sufficient material for partly or completely rebuilding any two gate leaves on the canal in case of accidental injury.

The work of erecting the lock gates proper began at Gatun May 17, 1911, and at Pedro Miguel August 7, 1911. The first work was done at Miraflores on September 10, 1912.

At the beginning of the fiscal year work was in progress on 23 gates, or exactly half the total number in all locks, but none of them had been entirely completed. The only gates stepped on their pintles and attached to the anchorages were the upper guard gates at Gatun, and even on these two gates much important work remained to be done. The total amount of steel assembled was only 19,361 tons, or about 34 per cent of the total, and much of this was only partly reamed and riveted. The total number of field rivets driven was about 963,000 out of over 5,700,000, or only 18 per cent of the total.

As the contract called for the completion by June 1, 1912, of no less than 24 gates out of a total of 46, the work had clearly fallen far behind the program, and a decided increase in the rate of progress was manifestly necessary. Realizing this the contractors decided upon a change in their local management, and beginning about September 1 installed much additional machinery, largely increased the force employed, and arranged for its more efficient supervision.

Within a few months the improvements in the organization became manifest, a high degree of efficiency being reached with a correspondingly large increase in the work done.

The gradual increase in the output from month to month may be followed on the diagrams given on drawing 5090, attached to this report (plate No. 78), which show in detail, from the beginning of the contract to the end of the present fiscal year, the rate of progress made in the manufacture of material in the United States, as well as in the field erection.

The number of white mechanics and colored laborers reached a total of over 4,600. As many as 165 rivet gangs were employed at one time, and the number of field rivets driven in one month reached

a maximum of 660,000 during March, compared with 213,000, the highest number driven in any month prior to September 1, 1912. The riveters were nearly all West Indian negroes, trained by white foremen on the lock gates.

By June 30, 1913, over 97 per cent of all material was assembled in the gates. Of the finishing, i. e., the work which remains to be done on each leaf after the riveting is completed, about 57 per cent had been accomplished at the end of the fiscal year.

All the leaves in the west chambers at Gatun and the east chamber at Pedro Miguel had been stepped on their pintles, and all the leaves in the west chamber at Miraflores, excepting the two leaves of the operating gate in the lower chamber. As the guard gates in both chambers of all the locks were also in place, the work which remained to be done, in order to permit the locking of vessels through all the locks, consisted mainly of the adjusting of the bearing plates, the testing for water-tightness, the painting, and the attaching of various minor parts.

At the end of the fiscal year all the guard gates were complete, except those at the lower end of Miraflores Locks. The guard gates at Gatun had been permanently closed.

Those at the upper end were put in service about July 20, 1912, although the depth of water at the sill has never exceeded 19 feet. The lower guard gates were closed about June 11, 1913, and sustain the maximum working head, about 40 feet, without appreciable leakage.

The original lock gate contract provides for the payment of 50 per cent of the contract price on all fabricated material ready for shipment at the contractors' works. A further 45 per cent becomes due on each pair of leaves when their erection is practically complete, while the final 5 per cent is withheld until all gates in a lock are entirely finished.

These provisions proved to be very onerous to the contractors, and it seemed clear that a more speedy completion of the gates would be ensured by relaxing these provisions where found unnecessarily severe. In consideration of certain concessions by the contractors, a supplementary agreement was signed January 14, 1913, which provides for successive partial payments on each gate, when the assembling, riveting, finishing, and painting of the same have been acceptably completed.

A further supplementary agreement, modifying some of the provisions of the lock-gate contract, was signed May 20, 1913. By its terms the contractors were given an extension of time for completing the gates.

The principal reason for granting this concession was the fact that a number of delays had occurred, for which, according to the terms of the contract, the contractors could not be held responsible. These delays were due in part to shipwrecks and strikes, in part to other unavoidable causes.

In the new agreement the commission received some minor concessions from the contractors in connection with the lock gate and other contracts, the rate under which the liquidated damages are to be computed was increased, while, on the other hand, new and later dates were fixed for the completion of the several gates.

These dates as now fixed are June 1, 1913, for the upper guard gates at Pedro Miguel, and June 15 for the guard gates at the lower approaches to Gatun and Pedro Miguel and the upper approach to Miraflores Locks. The lower guard gates at Miraflores are to be finished by September 1, 1913. All other gates necessary to permit the lockage of vessels through one side of each flight from ocean to ocean must be completed not later than October 1, 1913, while the date of final completion for all remaining gates is fixed at January 1, 1914, for Gatun and Pedro Miguel and March 1, 1914, for Miraflores.

The total weight of all the gates on the canal and also the weights of the different leaves are shown in the table given below.

This gives for each leaf the weight of metal as stated in Circular No. 576, inviting proposals, and the corresponding weights calculated from the shop drawings as well as the average scale weight of the leaves as built.

The total tonnage shipped is 57,552, as compared with 56,612 tons, computed from the general plans that accompanied the specifications, and 57,212 tons, calculated from the shop drawings.

The weight in tons of 2,000 pounds of a leaf of any given height may be quite closely expressed by the following formula:

$$W=10 H-87.$$

in which H equals the height in feet of the leaf from the top of the coping on the lock wall to the top of the sill.

*Weights of mitering lock gates.*

[Exclusive of fixed parts.]

Number of leaves.	Height of leaves, top of coping to sill.	Weight, in tons, of all metal, exclusive of fixed parts.					Total weight from contract drawings, I. C. C. Circular 576.	Total weight from shop drawings.	Total shipping weights.
		Estimates from contract drawings, I. C. C. Circular 576. Weight per leaf.	Variation from shipping weight.	Estimate from shop drawings. Weight per leaf.	Variation from shipping. Weight.	Actual shipping weights per leaf.			
8	47 feet 4 inches lower guard gates..	382	<i>Per cent.</i> 2.8	389	<i>Per cent.</i> 1.0	393	<i>Tons.</i> 3,056	<i>Tons.</i> 3,112	<i>Tons.</i> 3,144
4	47 feet 4 inches upper guard gates..	375	2.9	382	1.0	386	1,500	1,528	1,544
8	54 feet 8 inches.....	444	3.1	452	1.3	458	3,552	3,616	3,664
4	66 feet 6 inches lower guard gates..	559	0.7	564	0.2	563	2,236	2,256	2,252
40	77 feet.....	671	1.3	676	0.5	680	26,840	27,040	27,200
8	77 feet 10 inches.....	.....	.....	682	0.0	682	5,392	5,456	5,456
16	79 feet.....	695	2.1	704	0.8	710	11,120	11,264	11,360
4	82 feet.....	729	0.5	735	0.3	733	2,916	2,940	2,932
92	.....	.....	.....	.....	.....	.....	56,612	57,212	57,552



The weights in the above table include all metallic parts that swing with the leaf, except the pump, float and float switch, motors, and conduits and other electrical apparatus, the casting for attaching the operating strut, and the miter-forcing machine. The concrete in the footwalks, the coke and cement filling on the bottom girder, and the timber fenders and sill pieces are also omitted.

The weights of these additional parts aggregate 27 tons per leaf for those leaves of the lower-guard gates which carry the miter-forcing machines themselves, and 24 tons for the companion leaves in those gates. The corresponding weights for all other gates are 20.5 and 18 tons.

The fixed parts, i. e., the castings and structural parts to be embedded in the masonry, were, in part, furnished under the contract for the lock gates, but were mainly furnished under an earlier contract (Circular 513) and erected by the commission in connection with the concrete construction.

Their weights are given in the table below, which show that these parts for all the gates weigh about 15 per cent as much as the metal work in the gates themselves.

The weight of the fixed parts in tons may be expressed by the following equation:

$$W = .721H + 39.4;$$

H being, as before, the height in feet of the gate from coping to sill.

*Weight of fixed irons embedded in concrete for mitring lock gates.*

Height of leaves, coping to sill.	Weight per leaf, in tons.					Total number of leaves.	Total weight (tons).
	Sill reinforcement.	Parts supporting gate.	Anchor- age and yoke.	Reaction castings in hol- low quoin.	Total per leaf.		
47 feet 4 inches.....	21.2	7.6	23.4	21.3	73.5	12	882.0
54 feet 8 inches.....	21.2	7.6	23.4	25.8	78.0	8	624.0
66 feet.....	21.2	7.6	23.4	34.3	86.5	4	346.0
77 feet.....	21.2	7.6	23.4	42.2	94.4	40	3,776.0
77 feet 10 inches.....	21.2	7.6	23.4	42.7	94.9	8	759.2
79 feet.....	21.2	7.6	23.4	44.1	96.3	16	1,540.8
82 feet.....	21.2	7.6	23.4	46.3	98.5	4	394.0
						92	8,322.0

#### CHAIN FENDERS.

A somewhat detailed account of the studies made to determine the most desirable type of chain fender, with a description of the design selected for the construction of a trial unit, was given in the annual report for 1911.

This design was for a fender of the hydraulic type, consisting essentially of a heavy chain made from iron 3 inches in diameter, and the necessary machinery for raising and lowering it. The chain is normally stretched across the lock chamber at about high-water level and arranged to pay out under a constant stress when struck by a vessel, so as to bring the same to rest gradually.

The machinery for raising the chain and for lowering it to the lock floor to permit the passage of vessels consists of a system of sheaves and hydraulic cylinders, with the necessary piping and auxiliaries. It is operated by an electrically driven centrifugal pump.

The resistance to the paying out of the chain is produced by resistance valves, which are designed to maintain a constant predetermined pressure in the upper cylinder, so that the strain on the chain may never exceed the desired maximum.

A contract was let to the United Engineering & Foundry Co., of Pittsburgh, Pa., in accordance with their bid submitted November 4, 1911, for the construction of the principal parts of a sample fender. Under this contract the commission reserved the right to order the material for the other 23 fenders required at prices named in the bid.

The pumps and the electrical equipment were ordered of the General Electric Co., while the heavy steel anchor frames embedded in the masonry and the suction tanks were built by the commission at its own shops. The United States navy yard at Boston furnished the chain.

All material for the trial fender was delivered on the Isthmus by December, 1912; the erection was begun about January 1 and practically completed by March 1, 1913.

During March and April a number of tests were made with this fender. These experiments, which were made by the testing department of the electrical and mechanical subdivision, included two distinct kinds of tests.

In the first series the chain was raised and lowered, as it would be in actual practice, by operating the centrifugal pumps by means of the motors connected to them. The general operation of the machine, including the action of the moving cylinders, the girders, and the passing of the chain over the sheaves, was satisfactory from the beginning. The pumps and their motors proved of ample capacity for raising and lowering the chain in about one minute, the time originally specified. The mechanism for starting and stopping the travel of the moving cylinder, at the beginning and end of the stroke, also fulfilled its requirements perfectly.

A slight difficulty was experienced in the earlier tests from the leakage of air into the piping, which interfered somewhat with the proper operation of the pumps. This trouble was easily remedied by raising the suction tank so that practically all parts of the piping are always under at least a small hydrostatic head. A further improvement adopted consists in the addition of a by-pass controlled by a gate valve to that part of the piping which connects the bottom of the cylinder with the pump. A tee had been provided in the original plans to permit this addition. As now arranged, the main pipe is fitted with a check valve, which opens wide when the cylinder is being raised, while the valve in the by-pass is permanently set with a very small opening, which insures a slow motion on the down stroke and obviates the danger of producing a vacuum in the upper cylinder or the piping.

After these changes had been made the operation of the fender machinery was entirely satisfactory as far as raising and lowering the chain is concerned. The pressure in the upper and the lower cylin-

ders was recorded by indicators at all parts of the stroke, both when raising and lowering the chain.

The fact should also be mentioned that the chain, when being lowered, dropped very uniformly from both lock walls, and, apparently, in its final position, rested at the bottom for the full width of the lock chamber with its vertical part entirely within the chases in the walls.

The object of the second series of experiments was to test the operation of the fender under conditions similar to those that will prevail when the chain is struck by a moving vessel.

As may be seen by reference to the plans (see drawing No. 5224B, plate No. 79), the chain at such times will gradually pay out, touching the curved surface of the hawse-pipe castings in the walls over a constantly increasing arc of contact.

The movement of the chain will be resisted in part by its friction along the hawse pipes, in part by the internal friction of the machinery, but mainly by the hydrostatic pressure which acts against the upper surface of the moving cylinder. The function of the resistance valves is to maintain the last-named pressure at a constant magnitude. The valve selected is made by the Ross Valve Manufacturing Co., of Troy, N. Y. The tests made of the resistance valves and the assembled mechanism are described as follows by Designing Engineer Goldmark:

An extended series of comparative tests was made in the United States during May, 1912, on three valves of different types especially designed for service in these fenders.

Through the courtesy of the Prudential Life Insurance Co. these experiments were made at its power plant at Newark, N. J. While they were undertaken merely as a preliminary to the tests to be made with the completed fenders, they proved of great value in giving greater assurance that this type of fender could be counted upon to operate successfully in practice.

An 8-inch pipe was connected to the resistance valve on the high-pressure side and fitted with a quick-opening valve for regulating the amount of flow, while the discharge pipe below the resistance valve leads to a 12-inch Venturi meter for measuring the rate of flow.

Water under pressure was supplied by three high-pressure pumps and regulated by three accumulators, the pressure at the accumulators being about 750 pounds per square inch, while the discharge varied from 0 to as much as 3,400 gallons per minute.

By means of three gas-engine indicators, the drums of which were arranged so as to be revolved uniformly by a small electric motor, the pressures above the valve, above the Venturi, and at its throat were continuously recorded.

From the cards taken on the high-pressure side of the valve the exact pressure that prevailed at that point throughout the stroke of the cylinder can be studied, while the pressures at the Venturi enabled the rate of flow to be accurately determined.

Of the three valves tested two were obtained from commercial sources and one was made after a design prepared in this office. The first two gave very satisfactory results, even for discharges of over 3,000 gallons per minute. The high pressure curves obtained in the numerous tests were quite free from irregularities and surges, the pressures being comparatively constant throughout the whole period of discharge. The pressures recorded for rates of flow exceeding 1,800 gallons per minute were, however, from 100 to 150 pounds per square inch lower than those obtained when the discharge was less. This drop was, without much doubt, due to the greater friction in the pipe line between the accumulators and the valve, when the flow was increased.

The third valve, which was of the piston type, gave equally good results for rates of discharge up to 750 gallons per minute, but was not satisfactory in its operation for higher flows, which caused objectionable oscillations in the valve.

The shortness of the time during which the high pressure was maintained was due to the limited accumulator capacity. The first one of the valves tested is

practically a reducing valve of the spring type. It has a disk  $4\frac{1}{2}$  inches in diameter, with a conical seat which is attached to a stem that extends upward through the valve cover. Its lifting is resisted by an outside spring connected to the stem by a system of levers. The spring pressure, which is about double the total pressure on the disk, is adjusted by turning the nuts on three rods connected to the top yoke which holds down the spring.

The second valve tested is more complex. The main valve has a disk  $5\frac{1}{8}$  inches in diameter, a lower piston 6 inches in diameter, and an upper plunger 2 inches in diameter, all rigidly connected. The valve is almost completely balanced, but there is a slight excess in area on the high-pressure side, so that it remains closed except when pressure is admitted to the lower chamber by an auxiliary valve. The movement of the main valve depends on a rate of flow through the auxiliary valve into the lower chamber below the main valve, and the rate of discharge from this chamber through the needle valve. The spring in this valve is much smaller than in the first valve and is readily adjusted by a hand wheel. All the forces acting in the valve are decidedly smaller.

As noted above, both valves gave excellent results in the preliminary tests.

Only the first two types were selected for working test in chain fender room. One valve of each type was installed in both machinery chambers, Nos. S12 and S13, each valve being inserted on an independent pipe leading from the top of the upper cylinder to the suction tank. During the tests one of the valves was used at a time, the other being shut off entirely by gate valves. The tests were made in room S13 on the middle wall.

For the tests a Lidgerwood unloader, consisting essentially of a 60-ton winding engine mounted on a flat car, was placed on the opposite lock wall about 600 feet downstream from the chain fender machines. The unloader was made fast by cable anchorages in the nearby back fill and masonry, and was supplied with steam from a locomotive on the track in the rear of the unloader. The chain of the machine under test was then disconnected from the stud link chain composing the span across the lock and connected to the inch and a half steel rope on the winding drum of the unloader. The required tension in the chain of the machine under test was then produced by winding in on the unloader, thus causing the plunger of the fender machine to rise against the pressure in the upper cylinder. This pressure was controlled by the resistance valve. For the first set of tests the cable from the unloader made a direct line to the hawsepipe of the machine. In these tests the chain was pulled out of the hawsepipe at an angle of about  $12\frac{1}{2}^{\circ}$  to the axis of the lock.

The cylinder pressures were recorded by the indicators which had been used in the preliminary tests in the United States, the valves being set, by trial, for gradually increasing pressures.

In this first set of tests the chain was in contact with the hawsepipe, and the pressure curves throughout showed small periodic fluctuations, due to the successive links passing across the hawsepipe.

A number of runs were made with both valves at pressures varying from 170 pounds to 350 pounds per square inch. The power of the unloader was apparently insufficient to overcome the hydraulic resistance and the hawsepipe frictions when the pressure at the valve exceeded 350 pounds.

After the valves were satisfactorily adjusted the pressure curves for both valves were very uniform, with practically constant pressures throughout the stroke, except for the small oscillations due to chain friction. The plunger speed varied from 6 to 25 feet per minute (equivalent to flows of 350 to 1,470 gallons per minute), being limited by the capacity of the unloader; the low speeds correspond to the highest pressures.

In the second set of tests a snatch block was placed at the opposite wall, so that the chain entered the hawsepipe at an angle practically normal to the face of the wall, eliminating the hawsepipe friction and permitting higher pressures to be reached.

Four runs had been made with this arrangement when the cable parted. The pressures ranged from 310 to 370 pounds per square inch. The cards showed perfectly constant and steady pressures, without any of the small variations due to hawsepipe friction.

For the third set of tests the line was reeved around a three-ply system of sheaves, making the pull again practically normal to the lock wall. A series of runs was then made, using the valves alternately with pressures running up to about 550 pounds per square inch, at the plunger speeds as high as 8.4 feet per minute.

In the final test made the maximum pressure reached 630 pounds per square inch, when the chain parted near or on one of the lower sheaves. This pressure corresponded to a stress on the chain of less than one-half the breaking strength obtained in the shop tests. The pressure curves obtained in this last set of tests were also entirely satisfactory.

The conditions, when the fender is used in stopping a vessel, will undoubtedly vary considerably from those prevailing in the tests.

The results obtained are thought, however, to offer good ground for believing that in actual practice the chain can be counted upon to pay off under a fairly uniform stress, so that by setting the valves to a suitable pressure, a vessel, unless it is a very great size or moving at excessive speed, may be checked or stopped without breaking the chain.

In order to determine the most suitable pressure for setting the valves, it is proposed to make an additional set of tests for determining the hawsepipe friction. In these experiments the total pull in the cable near the unloader is to be measured by means of a hydraulic dynamometer, the pressures in which will be recorded on indicator cards. From these cards and those taken at the upper cylinder of the fender machine, the proportion of the total pull absorbed by friction is to be computed.

Both valves tested gave very good results in the tests, making the choice between them difficult. It is believed, however, that there are certain advantages in the type in which the pressure is regulated by an auxiliary valve, which make it more desirable for use in the chain fenders. The spring is much smaller, making it easier of adjustment and probably less likely to break under strain, while the main valve, not being under heavy stress, can be moved up and down by hand at any time, ensuring it against sticking fast. Finally, the inlet to the auxiliary valve can be connected directly with the cylinder, thus measuring the pressure at that point instead of in the piping just above the valve.

The tests indicated that there will be a decided drop in pressure between the cylinder and the resistance valve. Its magnitude is, however, uncertain and will vary with the rate of flow. The advantage is apparent of being able to set the valves for a definite pressure in the cylinder itself. For the above reasons the type of valve permitting this adjustment was selected for use in the fenders.

As the experiments with the trial fender, both when raising and lowering the chain and when paying off under strain, seemed entirely satisfactory, a contract was entered into with the United Engineering & Foundry Co. for the machinery parts for the remaining 23 units and the pumps; the electrical and other subsidiary equipment were also ordered.

In the lower approach to Miraflores locks, the great tidal range made a modified design necessary, which is shown on drawing 5351 (plate No. 80). In this plan the same system of cylinders is used as in the other fenders, and the pumps, piping, electric equipment, etc., are also practically the same. The chain is stretched across the lock for stopping vessels at either of two different levels according to the stage of the tide. The chain itself is endless, and there are two separate hawsepipes, idlers, and recesses in the walls and floor. By a simple chain-stop mechanism, which may be operated electrically from the central control house, the part of the chain that passes through either hawsepipe may be connected with the operating machinery and raised and lowered, the part which passes through the other hawsepipe remaining at rest, with its central portion lying across the bottom of the lock.

#### LOCK ENTRANCE CAISSONS.

The plans and specifications for floating caissons, referred to in previous annual reports, were completed during the fiscal year, and an invitation for proposals (Circular 779) was issued on May 21, 1913. Bids under this circular are to be opened July 21, 1913.

These two caissons, which are identical in design, will be used for closing the upper and lower entrances to the lock chambers when unwatering them, and will also contain a pumping plant of large capacity for pumping out the locks.

They are ship caissons, with curved surfaces throughout and vertical ends. Their extreme length is 113 feet 10 inches, the molded breadth 36 feet, the breadth of the top deck 18 feet, and the depth at the side 65 feet.

Transverse stability will be insured by the use of some 850 tons of concrete and iron ballast and by subdividing the interior by a continuous longitudinal bulkhead and numerous transverse bulkheads.

With fixed ballast only the caissons will float at a draft of 32 feet, which will be increased to a maximum of 61 feet by flooding when they are put in place on the deepest sills. To assist in keeping the caissons on an even keel, trimming tanks are provided at each end.

The longitudinal elevation and section and typical cross sections of the caissons are shown on drawings 7903 and 7904 (plates Nos. 81 and 82).

There will be five decks in all, the one next to the top being an open truss, the others of solid plate construction. To avoid all danger of accidentally scuttling the caisson, the deck which carries the operating machinery will be made water-tight. The freeboard will be 1 foot, with the water inside up to this deck. The transverse bulkheads are spaced at intervals of 12 feet, with smaller intercostal frames spaced 2 feet apart. The hydrostatic pressure will be carried to the ends by the decks and by intermediate breast hooks. The cushion timbers will be of green heart.

The total weight of each caisson, exclusive of ballast, is estimated at 1,570 tons, of which 140 is the weight of the pumping equipment.

The pumping system will include four centrifugal pumps of the volute type, with a 20-inch discharge, besides a small auxiliary pump. The average capacity of each of the large pumps, when pumping out the locks, is specified to be at least 13,000 gallons per minute, which would insure the unwatering of any of the locks within 25 hours.

The arrangement of the pumps and piping is such as to permit drawing the water from either side of the caisson and discharging it through the opposite side. This will allow the caissons to be cleaned and painted on both sides, when in place at the lock entrances, without special docking. After the water level in the lock has been lowered to about 3 feet of the lock floor through the regular suction pipe, the remaining water will be pumped out through a removable auxiliary inlet pipe, which will be temporarily connected to the caisson at a lower elevation.

The flooding of the caissons will be done by gravity, while two of the four large pumps are arranged for pumping them out.

The pumps and ventilating fan will be driven by electric motors, while the cranes and windlasses are to be operated by hand. Three-phase alternating current at 25 cycles will be used, the voltage to be 2,200 for the main pumps, 220 for the smaller pump and the fan, and 110 for the lighting.

The current will be carried from the lock walls by removable cables, leading to outlets at both sides at either end of the caissons.

## OPERATING MACHINERY AND ELECTRICAL INSTALLATION.

This subdivision has been under the immediate charge of Mr. Edward Schildhauer, electrical and mechanical engineer. The designing and drafting has been carried on with the assistance of Messrs. C. B. Larzelere and C. C. Coppin, assistant engineers, and the necessary draftsmen and clerks. Mr. Frank A. Browne, assistant engineer, has directed the inspection in the United States. The erection force on the Isthmus has been directed by Mr. E. E. Lee, superintendent of erection, and Mr. F. C. Clark, assistant superintendent of erection, with the assistance of Messrs. C. P. Fortney and T. H. Jordan, mechanical supervisors, Messrs. G. A. Balling and W. R. Holloway, electrical supervisors, and Mr. W. R. McCann, supervisor of hydroelectric station and transmission lines. Messrs. S. H. Grautten and R. H. Whitehead were employed as testing engineers, and Mr. E. C. Smith, jr., as local inspector.

## RISING STEM VALVE MACHINES.

Under the contract with the Wheeling Mold & Foundry Co. shipment was completed January 25, 1913, with the exception of thrust screws, which were manufactured abroad under subcontract. At the end of the fiscal year 94 per cent of the valves proper had been installed and the operating machinery was 92 per cent complete in mechanical erection, while the electrical installation of control panels, cables, and conduits was 40 per cent complete.

## FIXED IRONS FOR RISING STEM GATE VALVES.

The fixed ironwork arrangement for guiding the rising stem valve and forming the water seals was shown on plate 3 of the annual report of 1909.

When these irons were checked preparatory to installing the valves they were found to require correction. The work was done for all the valves at Gatun and all but two at Pedro Miguel by chipping and grinding with pneumatic hand tools. For all valves at Miraflores and the balance at Pedro Miguel the correction was performed with a milling machine especially designed by this office and manufactured by the mechanical division.

At the end of the fiscal year 94 per cent of the fixed irons had been corrected.

## TEST ON RISING STEM GATE-VALVE MACHINES.

At the close of the fiscal year 1913 tests had been made with satisfactory results on 39 rising stem gate-valve machines at Gatun, 20 at Pedro Miguel, and 8 at Miraflores Locks.

All machines are given a preliminary and an acceptance test. The latter consists of 10 cycles, made at five-minute intervals. The thrust screws are required to run silently, the temperature of the crosshead nuts must not exceed 50° C., and no heavy vibration is permissible. The power consumption must be normal and the parts in correct alignment, and all seals correctly adjusted.

*Operation of valve in the dry.*

	Opening valve.	Closing valve.
(a) Weight of valve and accessories, crosshead, and equivalent weight of roller trains.....pounds.....	31,500	31,500
(b) Side seal friction due to initial tension.....do.....	1,000	1,000
(c) Valve, stem, and roller train friction.....do.....	8,000	8,000
(d) Equivalent weight on crosshead ( $a \pm (b+c)$ ).....do.....	40,500	22,500
(e) Coefficient thrust screw friction.....do.....	0.073	0.083
(f) Thrust screw sliding friction.....pounds.....	23,900	14,700
(g) Binding friction between nuts and screws.....do.....	2,100	2,100
(h) Losses in gearing between motors and screws.....do.....	19,000	12,400
(i) Total machine and valve friction ( $b+c+f+g+h$ ).....do.....	54,000	38,200
(j) Total force to move valve ( $i \pm a$ ).....do.....	85,500	6,700
(k) Corresponding motor torque <sup>1</sup> (pounds at 1-foot radius).....do.....	510	40

<sup>1</sup> 480 revolutions of motor gives an 18-foot movement of the valve. Motor synchronous speed is 500 revolutions per minute. It takes 63 seconds to open valve and 58 seconds to close it.

## CYLINDRICAL VALVE MACHINES.

Under contract with the Wheeling Mold & Foundry Co., the last shipment of these machines was received January 15, 1913.

The mechanical installation of the 120 cylindrical valves was completed June 1, 1913; at the end of the fiscal year the electrical work of installing control panels and cables with necessary conduits for these machines was 41.6 per cent complete for all locks.

## AUXILIARY CULVERT VALVE MACHINES.

These are furnished under contract with the Wheeling Mold & Foundry Co. During the fiscal year 1913 the delivery and erection of all auxiliary culvert valve machines was completed and all control panels were erected for these machines. (For tests, see cylindrical valve machine tests.)

## TEST AND CORRECTION FOR LEAKAGE OF CYLINDRICAL VALVES.

The cylindrical valves were placed at the time of concrete construction by the construction divisions. When several valves were tested for leakage, under a 60-foot head in the condition in which they were installed, they were found to have an excessive leakage. The worst valve had an average opening around the seat of 0.038 inch, and in addition to this the leather seals at the top of the valves were not seated properly.

After correction of the seals, as described in the last annual report, the valve seats were ground by hand to a closer fit and tests were continued after successive grindings of the valve seat until the total leakage was reduced to a satisfactory value.

The results of the tests of leakage are tabulated below, together with the opening at the valve seat:

Successive grinding.	Average opening.	Maximum opening.	Leakage at 60-foot head.
As found.....	<i>Inch.</i> 0.038	<i>Inch.</i> 0.110	<i>Second-feet.</i> (1)
First.....	.016	.069	(1)
Second.....	.011	.047	0.99
Third.....	.0063	.031	.455
Fourth.....	.0034	.014	.060
Fifth.....	.0005	.003	.0075

<sup>1</sup> Excessive at low head.



As a result of the above tests it was decided to regrind all valves so as to allow a maximum average opening around the seat of 0.004 inch.

The leather seals and cast iron segment rings were installed after all grinding had been finished.

#### TESTS OF CYLINDRICAL VALVE AND AUXILIARY CULVERT VALVE MACHINES.

The operating machinery is the same for both cylindrical valve and auxiliary culvert valve machines, except that 60-inch and 36-inch strokes are required for the 60-inch and 36-inch auxiliary culvert valves, respectively, instead of the 32-inch stroke of the cylindrical valve.

In order to allow for slight over-travel of the machine after the valve has seated without injury to the machine, the valve stem is allowed to rise through the driving gear by means of the spline, and, to give the valve a seating pressure, the limit switch is adjusted to make this rise about one-fourth inch.

The motor torques and time required for opening the various types of valves are as follows: All machines of this class overhaul when closing, and usually reverse a small amount of power in the line.

Type of valve.	Motor torque (pounds at 1-foot radius).	Time to open valve.
	<i>Pounds.</i>	<i>Seconds.</i>
Semisteel cylindrical valve.....	79	10
Cast-steel cylindrical valve.....	69	10
60-inch auxiliary culvert valve.....	52	16
36-inch auxiliary culvert valve.....	41	10

The first 40 cylindrical valves were made of cast steel and the remaining 80 of semisteel.

#### GUARD VALVE MACHINERY.

The designs for the operating machinery of the guard valves were completed in August, 1912. The guard valves are to be used as duplicates to the upper rising stem valves in emergency or for use in closing the intakes in the side wall culverts for unwatering the culverts to permit access to other valves for painting and repairs. The design was determined largely by the cramped position in which the machines had to be placed. On account of the infrequency of operation, as well as their slow speed, the machine is simpler and cheaper than that for the rising stem valve.

The following are the essential features of the machine: The driving shaft, which carries three driving sprocket sheaves, is driven through a train of gears, consisting of a spur gear and pinion and a worm wheel and worm, by a 27.5-horsepower, 220-volt, 3-phase, 25-cycle motor, electrically a duplicate of the miter-gate moving machine. The main sprocket sheave on the driving shaft carries the gate hoisting chain which, after passing over another sprocket sheave on an idler shaft, goes to the gate counterweight in the counterweight

pit. The other two driving sprocket sheaves on the driving shaft drive the shafts carrying the sprocket sheaves, which in turn carry the two chains which operate the hoisting of the roller trains. These chains also carry small counterweights, which are suspended in the main counterweight pit. The roller train speed reduction of one-half the gate speed is obtained by having smaller sprocket sheaves for the roller train chains than the driving sprocket. (See drawings 6450 and 6451, plates Nos. 83 and 84.)

On November 14, 1912, contract for 18 complete machines, with the exception of motor, limit switch counterweight base, and counterweights, was awarded to the Earle Gear & Machine Co., of Philadelphia, Pa., for the sum of \$26,900. The price of the machines as awarded was \$0.0845 per pound. The counterweights and counterweight bases are being furnished by the mechanical division at a cost of \$0.0175 per pound.

At the end of the fiscal year the shipment was 50 per cent complete, but deliveries from the contractor were behind schedule from two to four months.

The work of correcting the fixed irons, assembling roller trains, assembling valves and seals, installing the babbitt seals and placing valves is about 75 per cent complete. Erection of machinery has been held up due to nonreceipt of material, and to date the shafts and pedestals of 33 per cent have been placed and the anchor bolts set in concrete for the balance.

#### MITER-GATE MOVING MACHINES.

Under the contract for miter-gate moving machines with the Wheeling Mold & Foundry Co., of Wheeling, W. Va., shipments with a complete delivery at Colon by May 1, 1913, were promised. The entire shipment was completed during May, 1913, but during the year the work has been handicapped by the nonreceipt of the parts that it was necessary to embed in concrete, and about which the erection of the whole machine hinged. At the end of the fiscal year 86 per cent of all machines had been installed.

The delivery of electrical equipment for these machines has been completed except indicating devices. The electrical work at the close of the fiscal year is 24.2 per cent completed.

#### MITER-GATE FORCING MACHINE.

At the close of the fiscal year the sample machine had been manufactured under contract with the Richard Manufacturing Co., of Bloomsburg, Pa., and shipped to the Isthmus for final test. As soon as the structural work of the gates would permit it was installed and given a test under approximately actual operating conditions. As a result several changes were made, and in consequence it was decided to allow the option for the remaining machines to lapse and to invite new bids. In all eight manufacturers submitted bids, of which the lowest, submitted by the Wheeling Mold & Foundry Co., was \$37,771.65 for the remaining 45 machines. The award was accordingly made to that company on November 23, 1912.

At the end of the fiscal year 100 per cent of the machines had been delivered. On account of the noncompletion of the work on the

structural gate parts the work of installation has been seriously delayed.

#### TEST OF MITER-GATE MACHINERY.

Test was made on July 31, 1912, on the upper guard gates at Gatun. These gates were practically completed as to all the main features. The miter-gate moving machines were installed complete, as was the miter-forcing machine. During the tests the machines were controlled from the machinery room in the center wall. The machines were adjusted so that when the strut arm was at dead center on the crank gear the gates were closed with a compression of the strut for gate No. 37 of five thirty-seconds inch and for gate No. 38 of nine thirty-seconds inch.

The limit switches of the machines were adjusted so that the gate traveled from its full miter position to the opposite position in the recess, at which point the machine was again on dead center.

The gates were started from the miter position and opened to their full position in the recess and again closed. They were then locked by the miter-forcing machine, although the gates were already in perfect miter. The lock was then removed. The time of operation of gate No. 37 was 1 minute and 51 seconds, and the time for gate No. 38 was 1 minute and 50½ seconds, the difference in time being probably due to error in observation. The whole operation was repeated a second time. During both operations the mitering of the gates was perfect. The machines had been adjusted separately, and although there was a noticeable small lead on one gate over the other, the gates came properly to closed position. Had there been time to adjust the gates simultaneously they could have been made to close with exact synchronism. The variation was, however, very slight.

Gate No. 38 was then left in its closed position and gate No. 37 opened a distance of 2 inches. The miter-forcing machine was then operated and gate No. 37 was forced to a point within three-fourths inch of perfect miter. This operation was repeated with gate No. 37 3½ inches from miter and was closed to a point five-eighths inch from miter. During these tests the miter-forcing machine was operating against the resistance imposed by the strut. The effect of these forces on the strut was measured at the slip joint and indicated the compression or elongation of the strut springs.

#### MITER-FORCING TESTS.

Start: Gate No. 38, against sill,  $\frac{1}{16}$ -inch compression.

Finish: Gate No. 38, against sill,  $\frac{3}{32}$ -inch compression.

Start: Gate No. 37, 3½ inches out, no compression.

Finish: Gate No. 37,  $\frac{3}{8}$  inch out,  $\frac{3}{16}$ -inch compression.

During tests the operation of the miter-forcing machine was entirely satisfactory.

#### TOWING TRACK MATERIAL.

The status of the material furnished under Circular 619 to date is as follows:

*Class 1.*—This includes all rolled-steel track material, and was 95 per cent complete on deliveries up to the beginning of the fiscal year 1913. During the year the delivery on this class was completed.

*Class 2.*—Under this class are the cast-steel towing track rack sections. The delivery, which was 44 per cent completed at the beginning of the fiscal year, was completed during February, 1913, including spare parts. The total linear feet, exclusive of spare parts, was approximately 53,950. Up to the end of the fiscal year, 36,908 linear feet of rack track had been installed complete with concrete, and 11,168 linear feet had been distributed and bolted up ready to be aligned and concreted.

*Class 3.*—This class covers malleable-iron supporting brackets for conductor-slot cover plates. At the beginning of the fiscal year 60 per cent had been delivered on the Isthmus and were reported as rejected in the last annual report. Later arrangements were made with the Ross-Meehan Foundry Co., the contractors, whereby they agreed to stand the expense of straightening the castings. Accordingly, a die was designed in this office and the castings straightened by the mechanical division with a steam hammer, at a unit cost of approximately 0.4 cent per bracket, so as to be acceptable. During the year the shipment of brackets was completed.

*Class 4.*—Copper T rails and splice bars for conductor rails. The delivery for this class was completed at the end of the last fiscal year.

*Class 5.*—This class includes crossovers and turnouts. During the fiscal year all delivery was completed, and on June 30, 1913, 25 per cent of single crossovers and 33 per cent of double crossovers had been installed.

The installation of conductor rails, insulators, cover-plate brackets, and cover plates has kept pace with the installation of completed track.

The installation of most of the return tracks has been performed by the Atlantic and Pacific divisions during their construction work.

#### TOWING LOCOMOTIVES.

Under Circular 650, bids were invited for the towing locomotive. The circular asked for bids on 1 locomotive and 39 locomotives, the idea being to give the first a thorough test before exercising the option to purchase the balance. The award was made to the General Electric Co., the lowest bidder. The tests on the sample locomotive showed that improvements were necessary to fulfill the conditions specified. As a result, order was placed for the required number of locomotives with alterations found necessary to overcome the defects made apparent by the test.

The first shipment is to be made on or before January 15, 1914, with a delivery of 4 locomotives per month thereafter until the shipment of 40 locomotives is complete.

#### TOWING TESTS—PANAMA RAILROAD STEAMSHIPS.

A series of tests were made in Limon Bay on ships of the Panama Railroad fleet at various speeds and rates of acceleration to serve as a check on the basis used for the design of the towing locomotives.

Tests were made on five ships, the size of which ranged from the steamship *Advance*, of 3,580 tons, to the steamship *Cristobal*, of 10,420 tons displacement, at actual draft at time of test. The tests

were made by the use of the tugboat *Empire*, length 120 feet, beam 24 feet, and depth 14 feet 6 inches, with a gross tonnage of 288 tons. The tug could exert a maximum pull at standstill of about 15,000 pounds. A manila towline of 7-inch girth was used, with a dynamometer consisting of spiral springs working between circular end plates with a steel scale for indicating the compression of the springs. It was calibrated several times during the tests and remained fairly constant.

The speed of the tug was measured by means of a Price current meter, mounted on the bow of the tug. This meter proved to be quite satisfactory in smooth water, but the accuracy to be obtained in rough water is doubtful on account of the severe end thrust on the meter pivots resulting from the pitching of the tug.

The start was made from rest in position alongside the dock, and the ship accelerated to the desired speed as quickly as the power of the tug would permit. The speed was then held constant until a sufficient number of readings had been obtained to insure representative results. Readings were taken of dynamometer pull, tug speed, angle of towline with center line of tug, angle of towline with ship, and ship's bearings. These readings were taken at intervals of 30 seconds throughout the run.

The results of the tests are shown on the curve sheet (plate No. 85), where the speed resistance curves are plotted for each of the ships tested on common axes of coordinates. These curves represent, with a fair degree of accuracy, the resistance which the various ships offer when being towed in open water. It is to be noted that each curve represents only a single test on a given vessel, and further that the runs were made in deep water without side walls.

The following tabulation gives necessary data covering Panama Railroad steamships and dates of test. These correspond to attached curves.

Date of test.	Vessel.	Length.	Beam.	Mean draft.	Displacement.	Wetted surface.
		<i>Fect.</i>	<i>Fect.</i>	<i>Fect.</i>	<i>Tons.</i>	<i>Sq. ft.</i>
Mar. 13, 1913 .....	Cristobal.....	505.0	58.0	17.75	10,420	42,182
Apr. 18, 1913 .....	Alliance.....	358.3	42.0	18.25	5,210	25,084
Apr. 24, 1913 .....	Colon.....	374.8	50.0	18.25	5,750	27,666
May 1, 1913.....	Advance.....	314.7	38.3	16.55	3,580	19,040
May 5, 1913.....	Panama.....	374.8	50.0	18.84	5,965	28,000

#### SPILLWAY GATE MACHINES.

The report for 1912 contained a description of the design and award of the contract for 22 spillway gate-operating machines and pumps for unwatering the counterweight pits.

During the year ending June 30, 1913, the delivery of all the machines was completed and a satisfactory test of the first machine erected was made. Up to the end of the year, mechanical work had been started on 85 per cent of the 14 machines at Gatun, and 71 per cent of the machines were practically completed. At Miraflores the work has not begun as the concrete construction is not far enough advanced as yet to permit it. The delivery of the electrical equipment for all spillway control is complete excepting the indicating

devices and remote control panels to be installed in hydroelectric plant at Gatun and in the control house at Miraflores. The contactor panels have been partially installed on six machines to date.

#### TEST OF SPILLWAY-GATE MACHINES.

Test made on the first machine to be installed in its position in the Gatun spillway indicated that the machine was very satisfactory. The device for shifting the gate upstream a slight distance after it is clear of the water, and the mechanism for raising the roller train out of the water after the pressure on the gate is relieved operated properly. The friction of the machine amounted to 30 pounds-foot at the motor, being approximately the same for raising and lowering the gate when 44,000 pounds are used on each counterweight.

#### TRANSFORMER ROOM EQUIPMENT.

The annual report of 1912 gave a description of the principal features embodied in the transformer and distributing rooms for the power and lighting of the locks. Up to the end of the last fiscal year the design had been completed and bids invited. After canvass of the bids the award was made on the general classes as follows:

General Electric Co., all lighting and power transformers, all oil switch banks, all ground plates, all insulating varnish, all control house lighting switchboards.....	\$166, 670. 00
Westinghouse Electric & Manufacturing Co., 16.060 pounds copper busses, cable-room equipment, varnished cambric tape.....	13, 369. 86
G. & W. Specialty Co., cable bells.....	23, 320. 00
Standard Underground Cable Co., cable bells.....	5, 385. 15

At this time award was also made for the item of low-tension switchboards for the transformer rooms, but on account of a misunderstanding of the quality of material to be furnished on the part of the contractors, the commission readvertised. The result of the readvertisement and canvass was the award of 36 switchboards to the General Electric Co. on their original combination bid for \$59,086 in September, 1912.

At the end of the fiscal year 95 per cent of the complete equipment for the transformer rooms had been received. The erection of the transformer-room equipment is progressing satisfactorily, and at the end of the year 35 per cent of transformer rooms had been practically completed and work had been begun on 30 per cent more. This gives an approximate total of about 65 per cent of all rooms on which work has been started.

#### INSULATED CABLE.

The total amount of insulated cable on order to date for all classes of work on locks and hydroelectric station, including the underground lines from the hydroelectric station to locks, is given below in schedule. Of the total amount of 2,372,110 feet, there are 1,394,600 feet of lead sheathed cable and 977,510 feet of rubber covered double-braided wire and cable.

The delivery on the above is approximately 93 per cent complete for all classes. To date, 462,729 feet of lead sheathed cable have

been pulled into the ducts, and a large part of the remaining ducts have been rodded and cleaned and are wired with fish wires for rapidly pulling in the remainder of the cable as needed.

The rubber covered wire for lighting and telephones will be installed later as the concrete work permits.

*Wire and cable on order.*

	Feet.
3-conductor 4/0 varnished cambric insulated lead sheathed.....	319,000
3-conductor 2/0 varnished cambric insulated lead sheathed.....	63,800
5-conductor #10 rubber insulated lead sheathed.....	238,500
8-conductor #10 rubber insulated lead sheathed.....	420,000
1-conductor 2/0 varnished cambric insulated lead sheathed.....	30,000
1-conductor #2 varnished cambric insulated lead sheathed.....	51,000
1-conductor #6 varnished cambric insulated lead sheathed.....	4,000
1-conductor #6 rubber insulated lead sheathed.....	50,000
1-conductor #6 rubber insulated double braid.....	134,000
1-conductor #10 rubber insulated lead sheathed.....	41,300
1-conductor #10 rubber insulated double braid.....	164,000
1-conductor #2 rubber insulated lead sheathed.....	88,000
1-conductor #12 rubber insulated lead sheathed.....	62,000
1-conductor #12 rubber insulated double braid.....	360,000
2-conductor #12 rubber insulated lead sheathed.....	39,000
2-conductor #12 rubber insulated double braid.....	73,000
1-conductor #23-61 stranded rubber insulated double braid.....	106,000
1-conductor #23-19 stranded rubber insulated double braid.....	120,000
1-conductor 1,000,000 c. m. stranded varnished cambric insulated lead sheathed.....	1,050
1-conductor 750,000 c. m. stranded varnished cambric insulated lead sheathed.....	1,000
1-conductor #4/0 stranded varnished cambric insulated lead sheathed.....	3,800
3-conductor 500,000 c. m. varnished cambric insulated lead sheathed.....	2,660
Total .....	2,372,110

All cable is pulled in ducts by a special winch made up on the Isthmus and driven by a small motor. The cable is greased and pulled through the ducts at the rate of 70 feet per minute.

A few lengths as long as 900 feet, where duct conditions have been favorable, were pulled without undue strain on the cable or appreciable abrasion on the lead sheath. A large number of observations have been taken to determine the amount of pull for various lengths and combinations of the different cables.

The severest conditions that have been encountered are as follows:

Kind of cable.	Feet of cable in duct.	Maximum pull (in pounds) required.
3-conductor 4/0.....	830	3,000
3-conductor 4/0.....	850	2,000
5 or 8 conductor control.....	550	1,300
2 control cables, any combination in one duct.....	500	1,300
3 control cables, any combination excepting 3-8 conductor in one duct.....	500	1,800
3 8-conductor cables in one duct.....	500	3,600

In the case of two or more cables in a duct, the pull shown is divided up among the cables.

The low pulls given for the severest conditions show that none of the cables have been excessively strained during process of installation.

## LOCK CONTROL AND INDICATING EQUIPMENT.

At the end of June, 1912, the study for lock control had been completed and tentative award had been made to the General Electric Co. for the whole of Circular 679, with the exception of the local chain-fender indicators. Upon the completion of drawings which showed the required features the final award was made to the above company.

The first two local indicators for chain fenders were manufactured, and as they were not entirely satisfactory the commission refused to exercise its option for remaining indicators. It has been decided to design mechanically operated signals and use standard railway-signal apparatus.

During the year a great amount of work has been done at the works of the contractor toward perfecting the complex interlocking system of the main control board and perfecting the indicating devices and the indicator transmitters.

The control scheme as completed will allow the control of every piece of machinery in the lock walls from a central control house situated on the center wall of the upper lock, where an uninterrupted view of the entire flight of locks may be had.

In this control house is located a control switchboard connected with every local control panel and indicating mechanism. The control board is so arranged that the indicator and control switch of each gate or valve machine is placed in the same relative position to other indicators and control switches as that occupied by the actual machines, so that by means of red and green lights and small models of gates and valves operated by synchronous transmitting mechanisms, the operator in the control tower will be able to tell at a glance the conditions in any part of the locks from the switchboard indications. These plans have been perfected during the year and the manufacture is going on rapidly, so that the first board will be ready to ship probably by August 1, which is as soon as the control houses will be completed. To date 38 per cent of indicator transmitters have been received.

## ILLUMINATION.

The general features of the illumination of the locks were described in the last annual report. During the year specifications were written and bids invited on miscellaneous lighting material. After canvass of the first lot of bids all were rejected, except that for distributing lighting panels, award for which was made to H. Krantz Manufacturing Co. for sixty 14-circuit and six 6-circuit panels, at a total cost of \$5,490.

On readvertisement for remainder of material award was made to the General Electric Co. to furnish snap switches for \$800 and to H. Krantz Manufacturing Co. to furnish 525 bronze outlet boxes for telephones and portable lamps in lamp-posts for \$10,925. The remainder of bids were rejected as the material proposed did not suit requirements and such material as is suitable is to be bought in open market.



A hollow concrete pole with concrete bracket arms and reflectors has been designed for supporting the lamps for exterior illumination of the locks and grounds.

The center-wall poles carry a single bracket and lamp projecting toward the chamber, and the side-wall poles carry double-bracket lamps so as to give a broad illumination over the lock chambers and the ground surrounding the locks.

The poles are arranged in four rows along the whole length of the locks, one row on each side wall and two on the center wall. The poles are spaced approximately 100 feet apart with a mounting height of 30 feet above coping level for the lamps. The lighting units used are 110-volt, 500-watt Mazda lamps.

In a preliminary test of lighting, with the inside of the reflectors painted with white enamel and using 400-watt lamps, the illumination was very satisfactory in the vicinity of the two lamp standards under test.

Designs have been prepared by this division for cast-iron molds for making ceiling and side-wall reflectors for tunnel and machine room illumination. None of these molds have been finished to date, but an early delivery is expected, after which the work of manufacture of interior reflectors will proceed.

The reenforcement of the exterior lamp reflectors is made of seven pieces of  $\frac{1}{4}$ -inch steel rod, consisting of a rim for the top of the reflector, one for the bottom, and five rods connecting the two rims. The pieces are first bent to correct shape, then welded together by a "spot" welding machine especially made on the Isthmus for that purpose.

#### HYDROELECTRIC PLANT.

The specifications and awards for generating equipment for the power house were included in the report of 1912. During the fiscal year 1913 all the above equipment was delivered, including the main generators and turbines, with exciter sets, traveling crane, penstocks, head gates, and operating machinery.

Bids were invited on auxiliary equipment for the hydroelectric station during the fiscal year, and award was made to the General Electric Co. to furnish the electric parts for \$39,216, and to the Niles-Bement-Pond Co. to furnish certain crane accessories for \$115.

The steel work for the hydroelectric station was advertised in September, 1912, and award made to the United States Steel Products Co. for fabrication and delivery at Colon. The contract included all steel for hydroelectric station complete, with steel for gatehouse, gatehouse stairway, stop logs, and small miscellaneous steel. The consideration will be about \$27,500. The delivery has been completed.

At the end of the fiscal year erection of the steel in penstock was 100 per cent complete, and all turbines had been set. The balance of the work of the installation of machinery is dependent upon the completion of the building for housing the electrical equipment. The work of erecting the building is being done by the Atlantic division.

The delivery of the equipment of the gatehouse and generating station is practically complete.

## TRANSMISSION LINE.

During the fiscal year it was decided to install for the transmission line an overhead system for 44,000 volts. This line is to extend from Balboa to Cristobal, and acts as a tie between the Gatun hydro-electric power station and the present Miraflores steam plant, so that they may be operated separately or in parallel, as necessary. Operating with this line are four substations, located at Cristobal, Gatun, Miraflores, and Balboa. The complete line consists of duplicate three-phase lines, one of which is carried on each side of track-span bridges spaced 300 feet apart on tangents and 200 feet on curves along the whole length of the Panama Railroad.

The bridges are of structural steel, with a clear track span of 36 feet, a clearance of 26 feet over the tracks, and an overall height of 40 feet.

The conductors are to be 2/0 stranded copper wire spaced with a clearance of 5 feet. They are supported from brackets outside of towers, with three-part suspension insulators, with noncorroding connecting links to allow a maximum life and a minimum of line troubles.

Contract has been made with the United States Steel Products Co. to furnish 777 double-track spans at \$541 each, and for 1,500,000 feet of 2/0 stranded copper wire at a unit price of \$0.0803 per foot (\$0.18 per pound), and 500,000 feet of five-sixteenths-inch copper clad ground wire at a unit price of \$0.0515 per foot (\$0.165 per pound). The total price for the above items, including anchors for towers, was approximately \$585,265.

The suspension insulators of three units each, of which there are 4,000, and the strain insulators of three units each, of which there are 2,500, are furnished by the Locke Insulator Co., at a cost of \$16.83 and \$18.88 each, respectively, with a total contract price of \$114,520.

At the close of the fiscal year no track spans have been delivered on the Isthmus. No insulators have been delivered, but 499,154 feet of copper wire has been received.

## COVER SEATS FOR CRANK GEAR—MACHINERY ROOMS.

At the end of the last fiscal year the contract for 92 complete cover seats had been let to the Standard Foundry Co., of Buffalo, N. Y., and 32 per cent of the total of 719,152 pounds of cast-iron and cast-steel cover seats had been delivered. During the year the remainder of the complete shipment has been received and approximately 71 per cent of the cover seats have been installed and concreted in place.

## CONCRETE.

In connection with the installation of machinery, it has proved necessary for the erection force under this division to install approximately 65,000 cubic yards of concrete.

## REDESIGN OF CARGO-HANDLING CRANES—BALBOA—PANAMA RAILROAD DOCKS.

At the request of the Panama Railroad Co. this division undertook the designing work in connection with the changing of the cargo cranes at Balboa from direct current to alternating current. The drawings covering the redesign are about 90 per cent complete.

## INSPECTION OF MACHINERY AND ELECTRICAL EQUIPMENT.

The force handling technical matters relating to inspection of electrical and mechanical equipment for permanent operation of locks, dams, and spillways has been continued throughout the year, with some reduction in connection with the contracts for lock machinery, transmission line, and hydroelectric station material hereinbefore described under the heading "Operating machinery and electrical installation"; also contracts for equipment for Balboa shops, Balboa Dry Docks, Balboa cranes, and Bascule bridge for the Panama Railroad Co., besides various minor contracts. The headquarters of this force remained at Wheeling, W. Va., during the year. The inspection work under the jurisdiction of this force has required, so far, a maximum of 60 men (during July, 1912), and at the close of the fiscal year this organization consisted of 25 men, 19 of whom are inspectors at an average salary of \$135.

During the year inspection has, at various times, been carried on at the works of 426 different main and subcontractors on completed and uncompleted contracts aggregating \$6,496,603.65. Of this total, 2 per cent was assigned to them by the general purchasing officer for inspection. Inspection of uncompleted contracts, at an aggregate price of \$3,547,302.73, was carried out during the year. The remaining uncompleted contracts are under inspection.

The inspection of the valve stems for rising-stem gate-valve machines at the Mannesmanrohren-Werke (Mannesmann Tube Works), Dusseldorf, Germany, subcontractor to the Wheeling Mold & Foundry Co. for valve machines, was satisfactorily completed during the year.

The inspection of thrust screws for rising-stem gate-valve machines, at the works of Nydquist & Holm, Trollhattan, Sweden, subcontractor to the Wheeling Mold & Foundry Co., was completed during the fiscal year.

Inspection has been performed by this force for the general purchasing officer on contracts amounting to about 3 per cent of the completed contracts. In connection with the contracts, 4,074 drawings have been submitted, checked, and approved, and 6,036 determinations made in the chemical laboratory connected with this branch of the inspection service. The average unit cost of determinations has been 53.4 cents, against 43 cents in 1912, owing to a smaller number of determinations made in 1913. Of the total determinations made approximately  $5\frac{1}{2}$  per cent were made for and at the request of other branches of the inspection service.

The total cost of maintaining this inspection force has been well within the estimate made for the fiscal year.

The total value of contracts inspected as of June 30, 1913, was \$5,059,058.16, this being the value of material inspected from the time of organization of this force. The total expenditure for inspection, including salaries, traveling expenses, nonexpendable property, and expendable property is \$155,688.38 since organization of the force. The percentage cost of inspection, therefore, for the entire time this organization has been in operation is 3.08 per cent.

#### GENERAL.

The designing and drafting for the year has consisted principally of the following:

A large number of drawings and sketches has been necessary for the use of the field in installing machinery, control apparatus for the various machines, cable ducts, cable-end bells, etc. Thirty-eight drawings were necessary for cable runs alone in the operating tunnels.

A design and specifications were prepared in this office for the end bells of the multiple conductor control cable. The specifications for these were issued under Circular No. 734, and included miscellaneous material for cable splicing.

Specifications were prepared for lighting material and issued under Circular No. 732. On account of the high prices bid on lamp reflectors, designs were prepared for lamp reflectors of concrete, to be manufactured on the Isthmus.

The guard-valve machinery drawings were completed and specifications prepared and issued under Circular No. 737.

Designs of many special tools were prepared for use in the field, including such items as the milling machine for milling the fixed irons of the rising-stem valves, a cable-pulling machine, and many smaller tools, jigs, and templets. A design was prepared for a rotary planer for the McClintic-Marshall Construction Co., for planing the end plates of the miter-gate leaves, but it was decided not to purchase same on account of time of delivery and cost.

Drawings and specifications were prepared for the steelwork of the hydroelectric station building and gatehouse. Specifications were issued under Circular No. 736.

Steel for roof trusses for the three control houses was purchased as an addition to Circular No. 736.

The design of the transmission line and substation equipments was prepared and specifications covering the material were issued under Circular No. 752. Drawings were also prepared for the cable duct lines across the Gatun Dam and from the Miraflores power station to the Pedro Miguel Locks.

Drawings were prepared for the foundations of the hydroelectric station building and machinery; also lighting and drainage plans and many other details.

General plans and elevations were prepared for the control houses and also details for steel beams and roof trusses; also lighting plans, sketches, and studies were made of the method of caring for the large number of cables which are to enter the control houses.

Specifications were prepared in this subdivision for the electrical equipment for the lock caissons.

## EMERGENCY DAMS.

This work has been under the immediate charge of Mr. T. B. Monniche, designing engineer, assisted in the inspection on the Isthmus during the whole or part of the year by Messrs. L. W. Tazewell, jr., R. E. Sexton, F. C. Purchase, and Lee Hooper. The inspection in the United States has been under the immediate charge of Mr. F. H. Moore, chief inspector.

## INSPECTION IN THE UNITED STATES.

During the fiscal year the inspection of material for the emergency dams was continued at the plants of the various subcontractors by an average of eight inspectors, one assistant inspector, and one clerk.

In addition to the 53 different plants of subcontractors mentioned in the last annual report, inspection was performed during the year at nine other plants.

During the month of January, 1913, the chemical laboratory at Munhall was abolished, and the material distributed between the chemical laboratories on the Isthmus and those of other subdivisions of the commission in the United States.

During the fiscal year the remaining shop drawings for the dams were approved. The total number of drawings required for Gatun and Pedro Miguel Dams is 1,084 and for Miraflores 1,009, but this does not include the drawings for girder and gate-hoisting machines, nor for electrical equipment.

The principal part of the structural material was fabricated at the Ambridge plant of the American Bridge Co.

At the Pencoyd plant of the American Bridge Co. the inspection of the gates and the machinery for turning and wedging of the dams has continued satisfactorily, and at this date practically all material has been shipped.

During the year full-sized tests upon the gates were made at the Pencoyd plant of the American Bridge Co. The requirements for these tests, as called for in the specifications, were as follows:

The gates shall be placed with their flanged wheels bearing upon 150-pound Cambria section crane rails, rolled of nickel steel. They shall then be loaded with pig iron uniformly distributed over their surface, and each test shall consist of three parts, as follows:

*First test.*—When loaded to the amount equivalent to the sum of the kinetic water pressure and the static water pressure while lowering, as given in Isthmian Canal Commission contract drawing No. 5505, the horizontal force required to start the gate rolling on the rails and keep it in motion shall in no case exceed 50 per cent of the total weight of the gate itself, not including pig iron.

*Second test.*—The load of pig iron on the gate shall then be increased to an amount equivalent to the maximum static water pressure, as given on drawing No. 5505. The flanged wheels and roller bearings of the gates must be able to resist this loading without injury to the material and without causing depressions or permanent sets, that would increase the friction and resistance in lowering the gates.

*Third test.*—The load upon the gate shall then be decreased to an amount equal to the sum of the kinetic water pressure and the static water pressure while lowering, as for test No. 1, and the horizontal force then required to roll the gate upon the rails must in no case be greater than was required under the first test.

The object of the tests is to insure that the friction upon the rails will not be so great as to prevent the lowering of the gates by their weight alone, and that no objectionable distortions or permanent sets will be produced by the maximum pressure to which the gates will be subjected.

The forces recorded during the first and the third tests for rolling the gates on the rails are listed below, same being expressed in percentage of the weight of each respective gate:

No. of gate.	First test.	Third test.
	<i>Per cent.</i>	<i>Per cent.</i>
1	4.2	2.6
2	3.4	3.4
3	4.2	3.5
4	4.3	3.4
5	1.6	1.5

In comparing the results obtained from the first and the third tests it will be noted that the forces required for rolling the gates on the rails during the third test are in each instance less than during the first test. It is evident, therefore, that neither the wheels nor the roller bearings suffered any injury by imposing the heavy load upon the gates as required by the second test. The reason for a smaller force being sufficient for moving the gates by the third test may be attributed to coating of the rollers and better distribution of the grease in the bearings, owing to the gates having been rolled under load during the first test.

Full-sized tests for the gate yokes were also made at Pencoyd Iron Works. All these tests were satisfactory.

#### SHIPMENTS.

Practically all structural material and turning and wedging machinery for the emergency dams was shipped to the Isthmus from Baltimore, Md., the pig iron for the counterweights from New Orleans, and several small items from New York.

With very few exceptions, material has arrived on the Isthmus in excellent condition.

#### METHOD OF ERECTION.

The method of erection of the emergency dams varied slightly for each dam, due to local conditions at the different sites. The typical manner of erection is described by Designing Engineer Monniche as follows:

Prior to erection the commission constructed three tracks, 32 feet center to center, leading up to the center pier of the emergency dam, as shown on plate No. 86. From these tracks all foundation castings, such as center pivot, wedge seats, rack and track castings, etc., were put in position. From the

middle track the wicket girders were placed in the pit provided for them, those nearest the center pier being placed first, and the track was then extended on top of the wicket girders.

Directly after the completion of this track, marked "B" on the accompanying sketch (plate No. 86), track A was extended on wooden bents from the center pier to the end of the long arm of the dam. As the extended position of track B served only for placing the wicket girders in temporary position and was of no further use, this track was torn up, and track C was extended from the center pier to the end of the long arm, this track also resting on the wicket girders. All the tracks were extended from the center pier by the contractor at his expense.

Bents and blocking to support the bottom chords of the vertical trusses were then placed directly upon the wicket girders, which served as a foundation for supporting the vertical trusses, as well as for the extension of track C. The wicket girders had been placed on heavy cribbing, so as to reduce the load per square foot on the underlying fill and to prevent the underpinning of the vertical trusses from settling. Notwithstanding this precaution it was necessary for the contractor at intervals during erection to wedge up the supports for these trusses.

The actual raising of structural steel was begun by placing the two heavy cross girders on the center pivot. These girders, weighing approximately 40 tons each, are to carry the whole load of the structure. They were put into position by means of two locomotive cranes traveling on tracks A and C. From these tracks the bottom chords of the vertical trusses were then placed in position upon the bents and blocking previously mentioned, which blocking was raised slightly above the calculated camber elevations. All chord splices were brought into perfect contact by the use of ship's jacks, after which the splices were riveted. When the full length of the bottom chords were riveted together the bottom lateral system was assembled from track B, the laterals on the long arm being placed in position by lifting them over the two center girders and lowering them into place with a crane. The bottom laterals of the short arm were then put in position, those nearest the center girders being placed first, and track B was torn up as the work on the laterals progressed toward the end of the short arm.

From the two remaining erection tracks, A and C, the two intermediate diagonals for the inclined center posts on each side of the cross girders were put into place, after which the main inclined center posts were assembled in the structure, being supported by the intermediate diagonals. After the inclined posts had been erected the hangers from their upper ends were assembled, serving as a further support for the inclined posts. The center posts of the vertical trusses were then erected, and all floor beams and sway bracing required for the members so far erected were put into place, after which the riveted diagonals for the trusses at the extreme end of the short arm, as well as all posts, floor beams, and sway framing for the short arm, were assembled. The I-bars of the top chords and those of the second diagonals of the long arm were erected, thus completing that part of the triangular system of the vertical trusses, which is pin connected.

The extreme end of the short arm was then let down to the calculated camber elevation, and the rest of the vertical trusses, the top lateral system, and sway frames, and the floor beams of the long arm were assembled, continuing the erection of these members toward the end of the long arm. Care was taken in maintaining the calculated camber elevations for each panel point as the assembling proceeded and in riveting the principal members of the vertical trusses directly after assembling. By this method of erection the load on the camber blocking was reduced and the desired shape of the vertical trusses, as well as the proper alignment of the horizontal truss, were obtained.

After completing the riveting of the vertical trusses, the extension of track C was removed, and the wicket girder booms, with their vertical framing, were erected on the upstream side of the dam, these being put into place by a locomotive crane traveling on the unloading track D. Simultaneously with this work from track A, the horizontal truss was assembled into the structure, starting nearest the end of the long arm. Each member of the horizontal truss was supported at one end by placing blocking under the tension chord of the truss near the edge of the lock wall, and at the other end by bolting it to the vertical truss. As the erection of this truss progressed, the booms and required framing supporting it were put into place, piece by piece, and not in the manner adopted for the erection of the wicket girder booms, which were bolted to

their framing on the ground and then assembled into the structure. As the erection of the horizontal truss continued toward the end nearest the center of the dam, the extension of track marked A was removed, and the placing of concrete and pig iron in the counterweight on the short arm was begun.

The floor stringers and plates were then assembled in the structure, and the erection of the hoisting machinery for the wicket girders and gates was started. After completing this work, and during the riveting of the various members already erected in the dam, one end of the wicket girders was raised until pin connection could be made with the compression chord of the horizontal truss. This was accomplished by means of a block and tackle attached to timbers laid across the floor beams. The other end of the wicket girders was also raised by block and tackle attached to the booms, and was held temporarily in place by cables.

The gates were then rolled along the wicket girders to a position directly beneath the hangers, which are attached to the floor beams. Four tiers of gates were hoisted to the hangers by means of block and tackle; the fifth tier of gates remaining in its final position on the wicket girders.

For transversal balance of the dams, concrete was placed in the tension chord of the horizontal truss for its whole length and extending part of the way in each of the inclined end posts.

The erection of the turning and wedging machinery was begun by bolting the various castings to their structural supports on the ground. Holes for these few bolts had been drilled previous to erection, while the remaining holes were drilled after assembling. The assembling of shafts, couplings, and gears, and the placing of the various parts of this machinery was carried on during the entire period of erection of the dams.

The conduits for the electrical equipment and the various electrical appurtenances were put into place as soon as the structural supports were erected, and this work also continued during almost the entire period of erection of the structural steel. Motors for the turning machinery, switchboards, etc., located in the operator's house and in the switchboard house, were erected immediately after the forms for these houses were removed. These houses were built as soon as the counterweight block was completed, and the work on the motors was completed simultaneously with the completion of these houses.

#### PROGRESS OF THE WORK FOR EACH DAM.

*East dam—Gatun.*—The first material shipped to the Isthmus was for the east emergency dam at Gatun, and arrived on the Isthmus on March 15, 1912. The shipments of material for this dam progressed slowly; delivery on the Isthmus was not completed until December, 1912.

The assembling of this material was begun about July 1, 1912, and was practically completed on March 1, 1913. More than 75 per cent of the material, however, was assembled by October 1, 1912.

Field riveting for this dam was carried on in a different manner from that of all the other dams, as the riveting was not begun for over two months after erection commenced, at which time the contractor had assembled over one-half of the material required. Riveting progressed at a uniform rate and was practically completed by February 1, 1913. Five months was required for riveting the principal parts of this dam, and two months more for riveting a few minor parts required for the completion of the dam.

*West dam—Gatun.*—The first shipment of material for the west emergency dam at Gatun was made about one month later than the first shipment for the east dam, but the shipments were completed at practically the same time, and delivery of this material at the site was also completed about December 1, 1912.

Erection began on November 9, 1912, and was practically completed in five and one-half months, or about March 1, 1913. Riveting was



started 20 days after erection began, at which time only about 170 tons of material had been assembled, and the riveting followed the erection so closely that both were completed at about the same time—May 1, 1913.

*West dam—Pedro Miguel.*—Delivery of material for this dam on the Isthmus began on November 1, 1912, and by March 1, 1913, 85 per cent of the material had arrived on the site, the remaining 15 per cent not having been delivered before the end of the fiscal year.

Erection of this dam began on February 1, 1913, and has proceeded uniformly up to this date, when practically all material received has been assembled. Riveting began on March 1, 1913, when only about 200 tons of material had been erected, and has progressed at a uniform rate. Practically all the riveting was completed by June 1, 1913, or three months after it was begun.

*East dam—Pedro Miguel.*—Delivery of material for this dam on the Isthmus began about December 1, 1912, and 85 per cent had arrived by March 1, 1913.

Placing the necessary castings on the masonry began on April 1, 1913, and by June 30 over 50 per cent of the material for this dam had been assembled in the structure and 30 per cent of the riveting had been completed. From June 1 to June 30 of this year the progress made in assembling and riveting has been slow on account of the contractor's shortage of workmen.

*East and west dams—Miraflones.*—Delivery of the material for these dams began on May 1, 1913, and up to the end of the fiscal year about 860 tons had been received.

Erection of the east dam began on June 1, 1913, and up to the end of the fiscal year about 160 tons had been erected.

Erection of the west dam began on June 13, 1913, and up to the end of the fiscal year 20 tons had been erected.

Riveting has not commenced for either of these dams.

#### FINAL TESTS OF THE EAST DAM AT GATUN.

For the purpose of adjusting the wedges of the emergency dams prior to the final tests, the contractor on April 17, 1913, swung the east dam at Gatun by hand about 10 feet on the rack quadrant with 16 men. On May 3 the dam was swung also by 16 men across the lock chamber, the wedge-operating machinery being operated by hand, requiring 6 men. The wicket girders and gates were then lowered, and all necessary adjustments were made.

On May 20, the contractor began the final tests of this dam, the total time for closing the dam in the first test being 1 hour 1 minute and 30 seconds.

After three complete operations of the dam were made, as required by the contract, the contractor started the second part of the tests, consisting of operating the turning and wedging machinery for 20 days, at intervals, depending upon the heating of the motors. This part of the tests was made principally for the purpose of limbering up the turning and wedging machinery. After completing the second part of the tests, three additional complete operations were made in accordance with the contract. The last of these tests was made in 42 minutes and 17 seconds, which is 19 minutes and 13 seconds less than the time occupied in the first test.

The results of all tests made show that the time used for the actual operation of the various parts of the dam varies but little for the different tests, the largest variation being in no instance more than 5 seconds. The only exception to this was the turning of the dam into position across the lock chamber, the minimum recorded time for which was 1 minute and 29 seconds and the maximum time 2 minutes and 22 seconds. The reason for the large variation is due to the necessity for restarting the motors after the limit switch has been brought into action; this limit switch serving as a safeguard against faulty operation.

The time recorded for the actual operation of the various parts of the dam in the last test was as follows:

	<i>Mins. Secs.</i>	
Drawing wedges.....		19
Turning dam.....	1	44
Driving wedges.....		20
Lowering wicket girders.....	4	40
Lowering gates No. 1.....	3	02
Throwing clutches for gate No. 2.....		49
Lowering gates No. 2.....	3	25
Throwing clutches for gate No. 3.....		49
Lowering gates No. 3.....	3	03
Throwing clutches for gate No. 4.....		49
Lowering gates No. 4.....	2	32
Throwing clutches for gate No. 5.....		49
Lowering gates No. 5.....	2	02
Total.....	24	23

As the total time required in bringing the dam into position was, as stated above, 42 minutes and 17 seconds, the time lost between the various operations was 17 minutes and 54 seconds. This lost time can probably be reduced by the employment of skilled workmen in operating the dam.

The minimum time in which the dam was brought back to its original position was 1 hour 27 minutes and 59 seconds.

#### AIDS TO NAVIGATION.

This subdivision has been under the immediate charge of Mr. Walter F. Beyer, assistant engineer, assisted by Mr. Charles Stubner, supervisor, and the necessary draftsmen, clerk, and field force. Lieut. A. H. Acher, United States Army, junior engineer, assisted on this work during part of the year.

The following work was performed during the fiscal year:

Range towers Nos. 13, Pacific division, and 2, 3, 5, 7, 9, 11, 15, 16, 17, 18, and 27, Gatun Lake section, were completed except that exterior stair railings must be erected at three of the towers, interior stair railings set up in one of them, lantern glass set in place in six, painting done, and permanent lights installed in all the towers.

The towers are of reenforced concrete, as described in the last annual report, and the heights from base to focal plane vary from 28 feet 10 inches to 87 feet 10 inches. Tower No. 2, Gatun Lake section, which is 87 feet 10 inches from base to focal plane, is located on the rock fill in the rear of the northerly end of the west wall of the upper locks at Gatun. In order to secure a good foundation it

was necessary to go down to bed rock. A cylindrical reenforced-concrete open-caisson foundation 18 feet external diameter and 15 feet 6 inches internal diameter was sunk to a depth of 65 feet below grade, after which the caisson was back filled with clay and spoil. The total concrete in the caisson amounted to 184.5 cubic yards and the total excavation to 534 cubic yards.

In order to obtain the necessary horizontal distance between the pairs of towers forming ranges, the front towers, Nos. 3, 5, 11, and 17, were founded on reenforced-concrete cylinders from 18 to 20 feet diameter and from 14 to 24 feet high, which, when the water of Gatun Lake rises to elevation 85 feet will form submarine foundations. Towers Nos. 17 and 18 are shown on plates Nos. 15 and 16.

Three skeleton tower beacons, Nos. 5, 7, and 8, which mark the edges of the channel between Balboa and Miraflores, were completed. They are founded on clusters of five concrete piles, and are 12 feet 6 inches square at the base, tapering to 4 feet 4 inches at the top. The total height of the beacons is 38 feet 4 inches from base to focal plane. Beacon No. 5 is shown on plate No. 17.

The reenforced-concrete foundation for the beacon at Santa Cruz was completed. It is 12 feet in diameter and 8 feet high, and when the water of Gatun Lake rises to elevation 85 feet will be a submarine foundation.

Eighteen concrete-steel reference and range targets were completed in the Gatun Lake section. A typical target is shown on plate No. 18. There will be approximately 32 such targets in the lake region, by means of which the gas buoys may be located from previously determined angles. At Bohio, Pena Blanca, Caimito, Mamei, Juan Grande, and Bas Obispo these reference targets also form unlighted ranges which mark the axes of the short channels at those places.

The reenforced-concrete caisson for the west breakwater light and fog signal, which was begun in June of the last fiscal year, was completed up to a height of 25 feet, after which it was sunk at the inner end of Limon Bay in 20 feet of water, where it will remain until its riprap foundation at the outer end of the west breakwater has reached its final settlement. The riprap foundation which was constructed in 42 feet of water, by the Atlantic division, is in the form of a truncated pyramid, the top of which is 22 feet below mean sea level.

The plans for the west breakwater light and fog signal have been revised, and the structure as shown on plate No. 87 will supersede the one shown in last year's annual report. It is expected that work on this structure will be begun before the next dry season sets in.

An electric-light line was installed from the Aguadulce pumping station to range towers Nos. 1 and 2, and beacons Nos. 5 and 7, Pacific division. The line is about  $2\frac{1}{2}$  miles long, and consists of 75 three-inch galvanized-iron poles set in concrete foundations, with the necessary cross arms and insulators to carry two No. 6 copper wires. Electric lights are exhibited from all the foregoing structures. A trench was dug and cables were laid from the Miraflores power station to the rear range tower of range No. 12-13, Pacific division, about 1,600 feet distant, and temporary electric lights have been installed in both towers.

Fifty-one concrete buoy sinkers 48 by 48 by 26 inches, and 45, 24 by 24 by 18 inches were fabricated at the Balboa plant of the light-house subdivision and, as that completed all the work contemplated at this plant, work there was discontinued and a new casting plant established at Gatun, where this subdivision has begun to cast 304 single arm and 207 double arm reenforced concrete lamp brackets, 511 concrete balls and 511 collars for the electrical and mechanical subdivision of this office. At the close of the fiscal year 30 single arm and 20 double arm brackets and 69 balls and 49 collars were completed.

A reenforced concrete wharf 70 feet long and 30 feet wide, adjoining the small boat landing at Gatun, was built for this subdivision by the Panama Railroad. This wharf will be used for storing, painting, and repairing gas and spar buoys belonging to the Gatun Lake section.

#### CLEARING AND SURVEYS.

Approximately 250 acres of canal prism from San Pablo to Pena Blanca, P. I., were cleared of trees and brush by this subdivision for the central division; and approximately 180 acres of land were cleared of trees in the vicinity of Mamei for the sixth division.

The necessary surveys and reconnaissances in the Gatun Lake region were made for the construction of range towers, reference targets, and beacons.

#### GAS BUOYS.

During the fiscal year a contract was made with the American Gasaccumulator Co., of Philadelphia, Pa., for furnishing 57 gas buoys. The contract price was \$164,970. All the buoys have been delivered on the Isthmus, and six of these were placed on their stations at the Pacific entrance to the canal. These buoy lights were exhibited for the first time on April 1, 1913.

The Goodyear gas buoy which has been in use at Porto Bello has been withdrawn from that station, overhauled and painted at Dock No. 13, and will be permanently placed on station in Limon Bay to mark a 22-foot shoal spot about halfway between the end of the west breakwater and Colon.

#### EQUIPMENT.

Drawings and specifications were prepared and prices asked from various firms for the following material and supplies:

Cedar logs ranging in length from 20 to 50 feet, for spar buoys-----	102
130 watt focusing Tungsten lamps-----	50
100 watt focusing Tungsten lamps (which it is estimated will be a year's supply for all electrically lighted range towers and beacons)-----	400
4th-order range lenses and frames-----	2
Pressed glass semaphore lenses, 12 inches diameter-----	36
Pressed glass sectors, 120 degrees each-----	134
Spherical mirrors for lens lanterns-----	67
300 mm. lens lanterns for electrically lighted beacons-----	50
300 mm. lens lanterns for acetylene lighted beacons-----	5

## ILLUMINANTS AND ILLUMINATION.

Experiments were made with Tungsten lamps having a spirally wound filament concentrating the light source to spheres of one-half inch for 100-watt and five-eighths inch for 150-watt lamps, and as these proved successful, that type of lamp will be used throughout for all electrically lighted range towers and beacons. Experiments have also been made with special flashing devices and lamp shifters for electrically lighted towers and beacons, and bids for their manufacture will be asked for in the near future.

The candlepowers of the various lights which will be used will be as follows:

Range No. 5-6, Atlantic section, and No. 1-2, Pacific section, which mark the sea channels at the Atlantic and Pacific entrances to the canal, respectively, will be equipped with fourth-order range lenses and 150 candlepower focusing Tungsten lamps, and each light will give approximately 300,000 candlepower.

The other ranges marking the various channels throughout the canal will be equipped with 12-inch semaphore lenses, and in those in which 100-watt electric lamps are used the resulting candlepower will be approximately 45,000 candles; those in which 60-watt lamps are used, 30,000 candlepower. Where it is necessary to use spherical mirrors in conjunction with the lenses the candlepower will be increased about 35 per cent.

Where 100-watt lamps are used in the beacon-lens lanterns the resulting candlepower will be approximately 1,200 candlepower, and with 60-watt lamps about 750 candlepower.

In the range towers equipped with acetylene gas and 12-inch semaphore lenses the resulting candlepower will vary from about 12,000 to 24,000, according to the size of burner used.

In the gas buoys and beacons equipped with 300 m. m. lense lanterns burning acetylene gas the resulting candlepower will be from 350 to 450, according to the size of burner used.

During the fiscal year fourth-order range lenses were installed in range No. 1-2, Pacific section, 12-inch semaphore lenses in range No. 12-13, Pacific section, and range No. 5-6, Atlantic section; and 300 m. m. lens lanterns on beacons Nos. 5 and 7, Pacific section. Electric lights are maintained in all the foregoing for use in connection with dredging operations.

## GENERAL.

In carrying out the work of constructing the range towers and reference targets in Gatun Lake section, the working forces were quartered in camps near the several sites, and the material was delivered on barges towed by a steam launch. As a number of the sites are very inaccessible, the handling of material became a very expensive item in the construction of the structures, in some cases being in excess of the total cost of labor for construction.

During the fiscal year, general and detail drawings and sketches were made for the West Breakwater light and fog signal, Range Tower No. 2, Gatun Lake, submarine foundations for towers Nos. 3, 5, 11, and 17, Gatun Lake section, 300 m. m. lens lanterns for gas and

electrically lighted beacons, fourth-order range lenses, stair railings, steel platform for beacons, submarine bells, flashing and occulting devices, etc.

# CONTRACTS.

Exhibit 1, attached, is a list of uncompleted contracts which have been let on specifications prepared by this division.

Respectfully,

H. F. HODGES,  
Colonel, Corps of Engineers, U. S. Army,  
Assistant Chief Engineer.

Col. GEORGE W. GOETHALS, United States Army,  
Chairman and Chief Engineer, Culebra, Canal Zone.

## EXHIBIT 1.

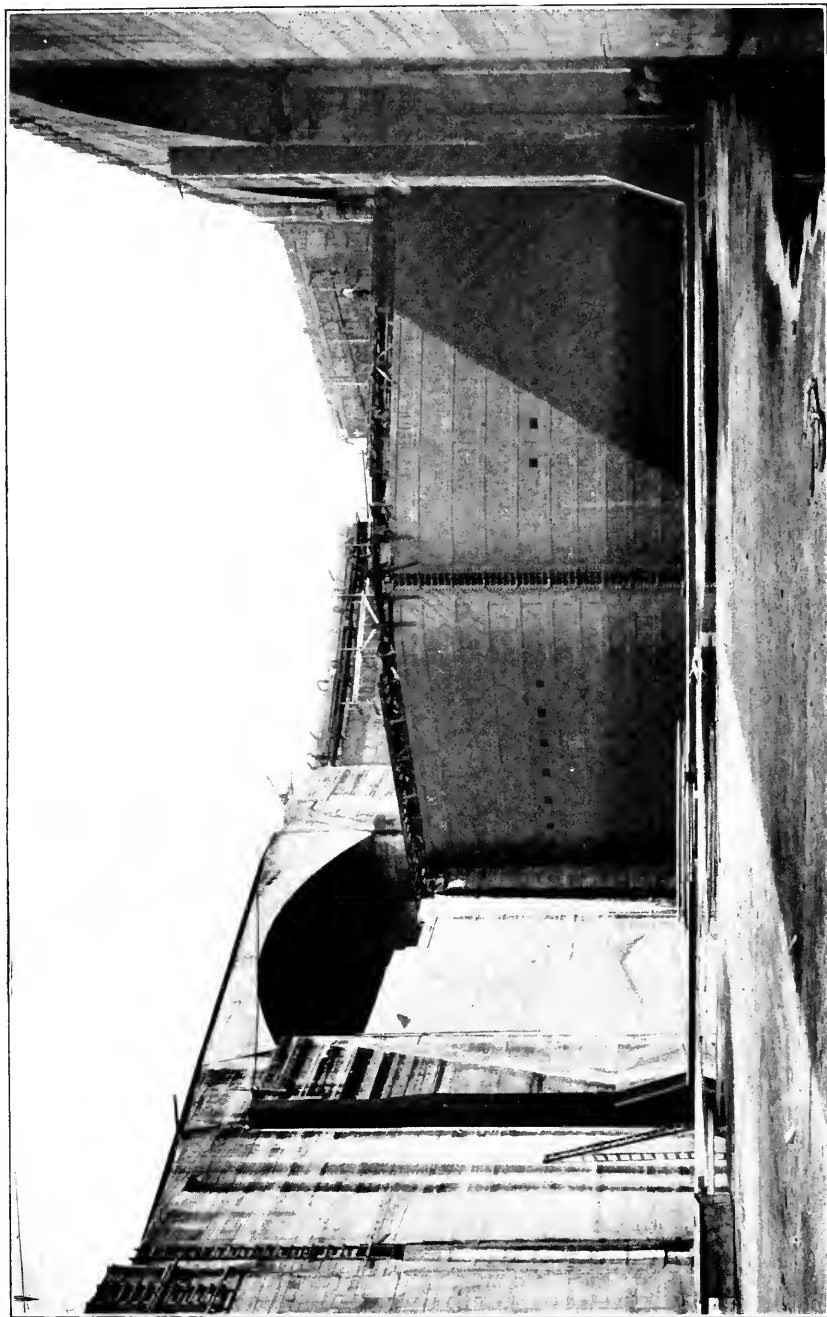
List of uncompleted contracts—First division, chief engineer's office, as of July 1, 1913.

[Erection or installation performed by contractors.]

Circular No.	Contractor.	Material.	Amount.	Per cent delivered.	Per cent erected.
576	McClintie-Marshall Construction Co.	Mitering lock gates.....	\$5,762,615.00	100	85
616	U. S. Steel Products Co.....	Emergency dams.....	2,243,068.38	70	62

[Erection or installation performed by commission.]

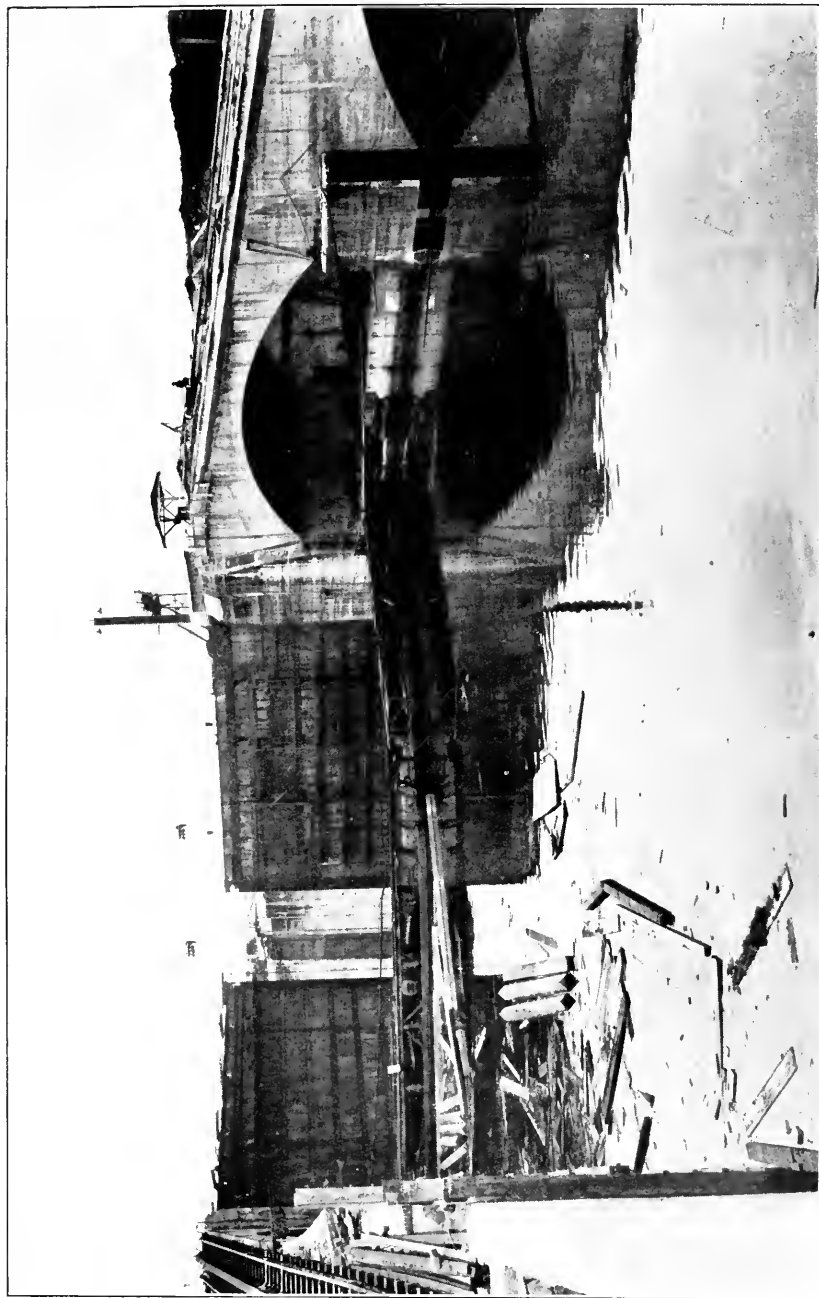
649	United Engineering & Foundry Co.	Chain fenders.....	\$428,005.00	.....	4
650	General Electric Co.....	Towing locomotives.....	523,680.00	.....	.....
679	do.....	Lock control equipment.....	202,152.56	.....	70
681	do.....	Motors, pumps, compensators, and float switches.	144,522.88	.....	75
695	do.....	1,045,300 feet control wires and cables.	460,868.95	.....	85
695	National India Rubber Co.....	539,300 feet control wires and cables.	20,569.05	.....	98
705	General Electric Co.....	Electrical equipment for transformer rooms.	237,194.50	.....	98
705	Standard Underground Cable Co.	Cable and bells.....	9,134.95	.....	85
715	General Electric Co.....	Hydroelectric station switchboards.	40,339.50	.....	80
732	H. Krantz Manufacturing Co.	Telephone outlet boxes.....	11,477.50	.....	.....
732-A	General Electric Co.....	86,850 feet control wires and cables.	13,529.97	.....	15
732-A	F. Bissell Co.....	135,000 feet control wires and cables.	6,680.33	.....	26
736	U. S. Steel Products Co.....	Roof steel for control houses.	11,136.00	.....	.....
737	Earle Gearing & Machine Co.....	Guard valve machines.....	26,900.00	.....	33
752	U. S. Steel Products Co.....	2,000,000 feet copper conductor wire.	132,055.03	.....	25
752	do.....	777 towers, double-track span	437,062.50	.....	2
752	do.....	6,500 high-tension strain and suspension insulators.	114,520.00	.....	.....
765	Mesker Bros. Iron Co.....	99 steel doors for entrances to operating tunnels.	4,398.00	.....	.....
765	Vulcan Rail & Construction Co.	Spillway railings.....	3,312.00	.....	.....
769	U. S. Steel Products Co.....	40,000 feet triple braid rubber and varnished cambric cable.	24,080.00	.....	.....



GATUN LOWER LOCKS. LOWER GUARD GATES, WEST CHAMBER, READY FOR ENTRANCE OF ATLANTIC OCEAN WATER. JUNE 14, 1913.

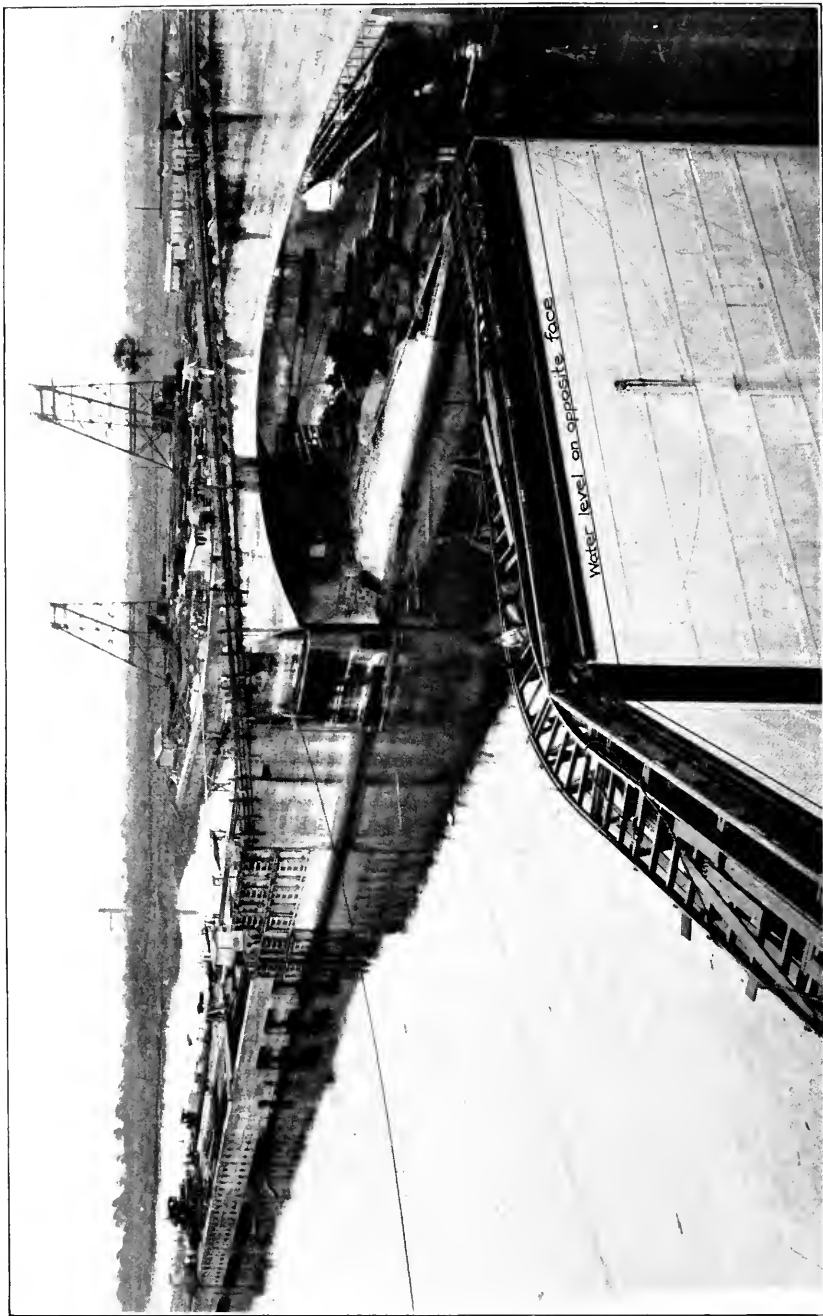






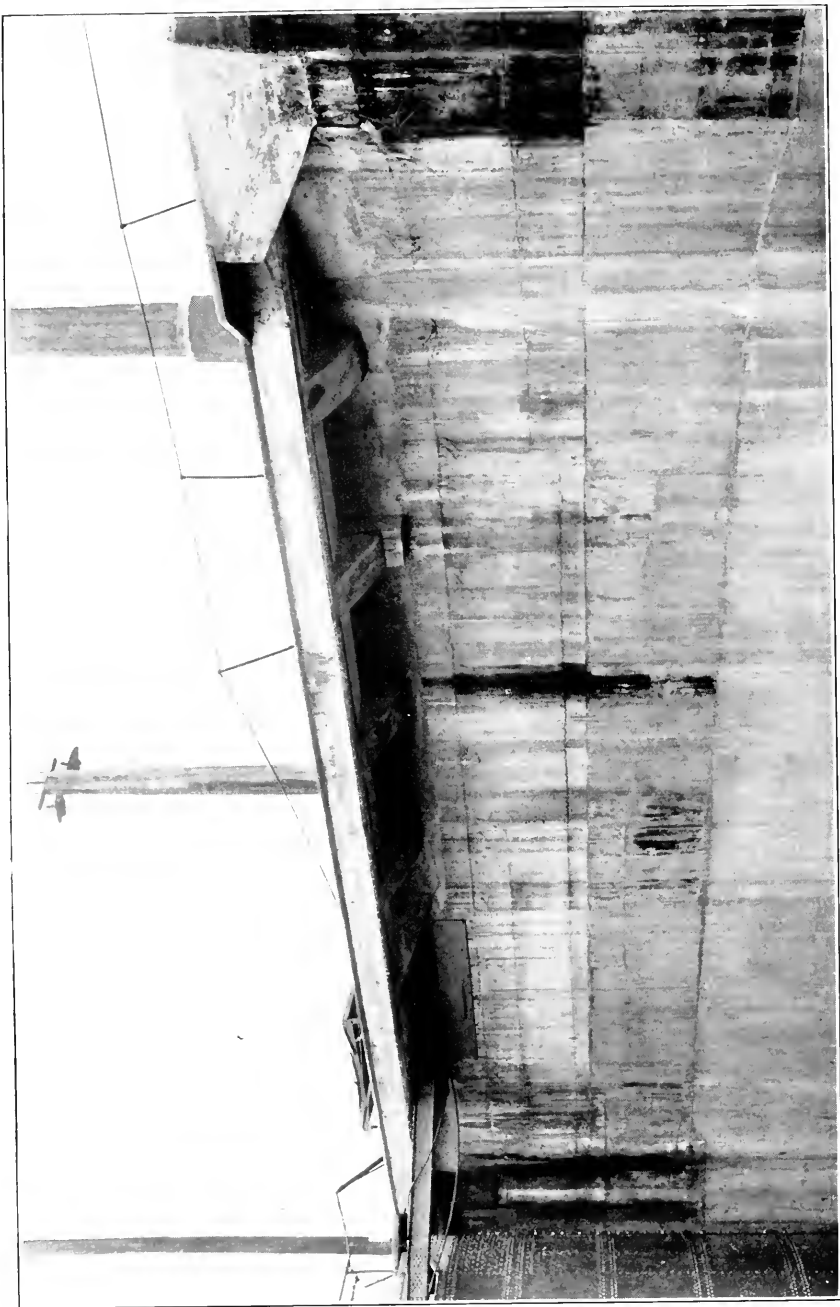
GATUN LOWER LOCKS. NORTH ENTRANCE TO WEST CHAMBER, SHOWING SEA GATES UNDER FULL PRESSURE, KEEPING LOCKS FREE FROM WATER. JUNE, 1913.





GATUN LOWER LOCKS. LOOKING NORTH, SHOWING WEST SEA GATES UNDER PRESSURE. JULY 2, 1913.





MITER GATE RECESS COVER.

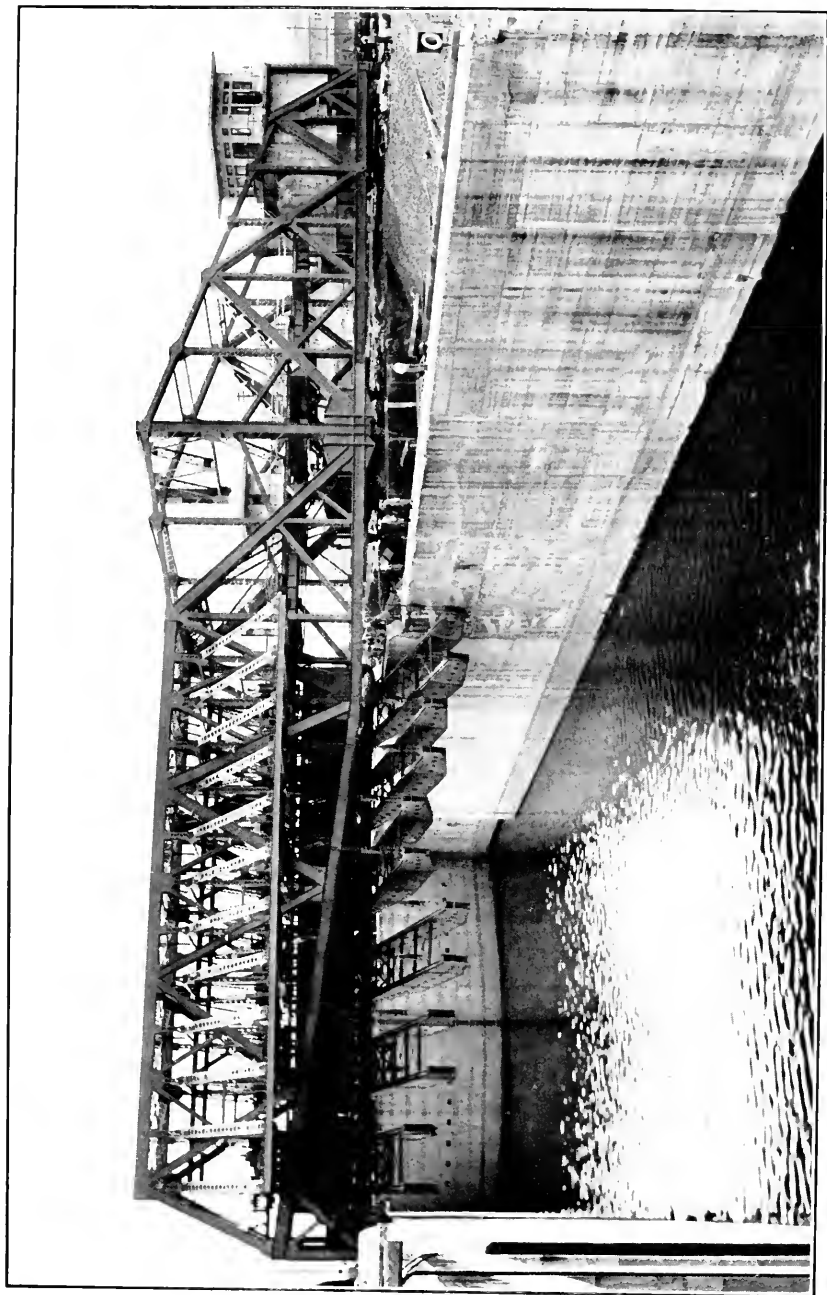




HYDROELECTRIC PLANT, GATUN. GENERAL VIEW OF LOCATION AND STATUS OF WORK. FROM WEST WALL OF TAILRACE, LOOKING SOUTHEAST. JUNE 27, 1913.

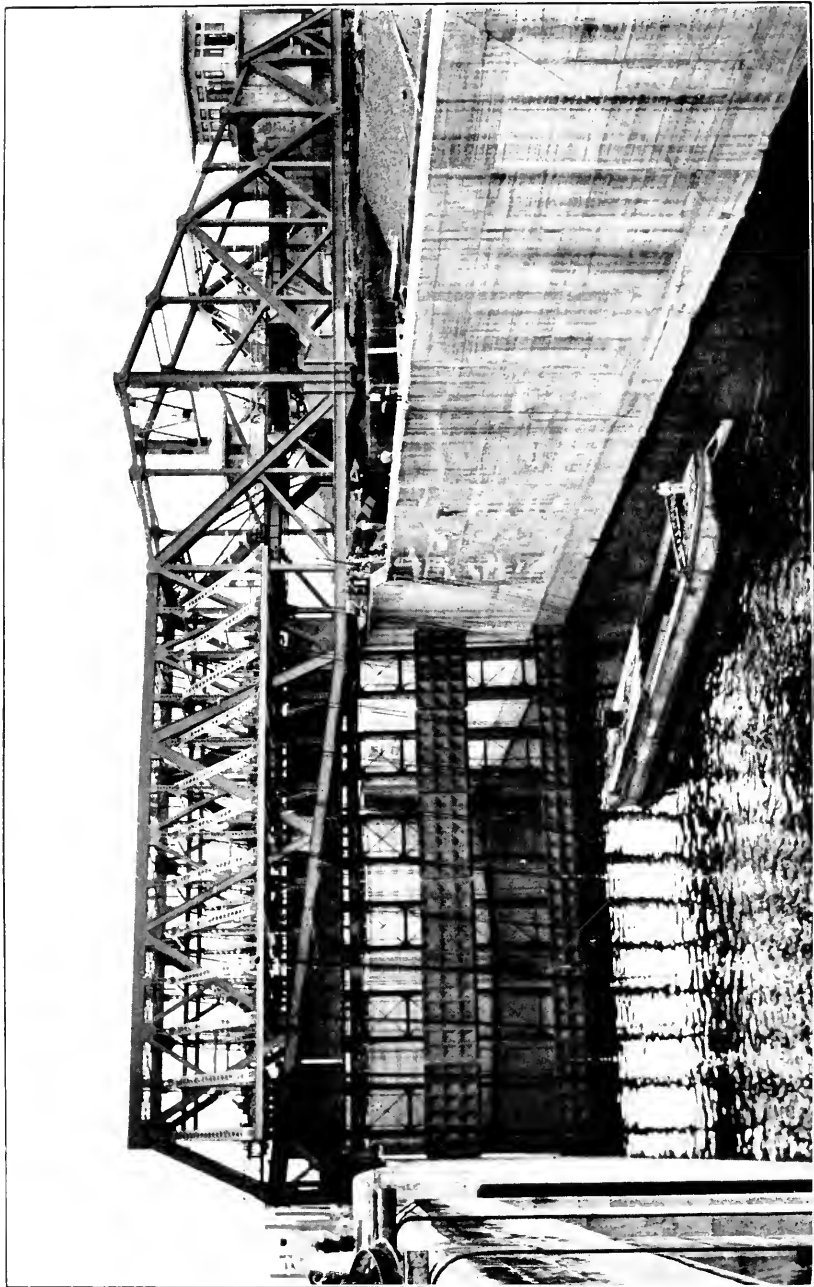






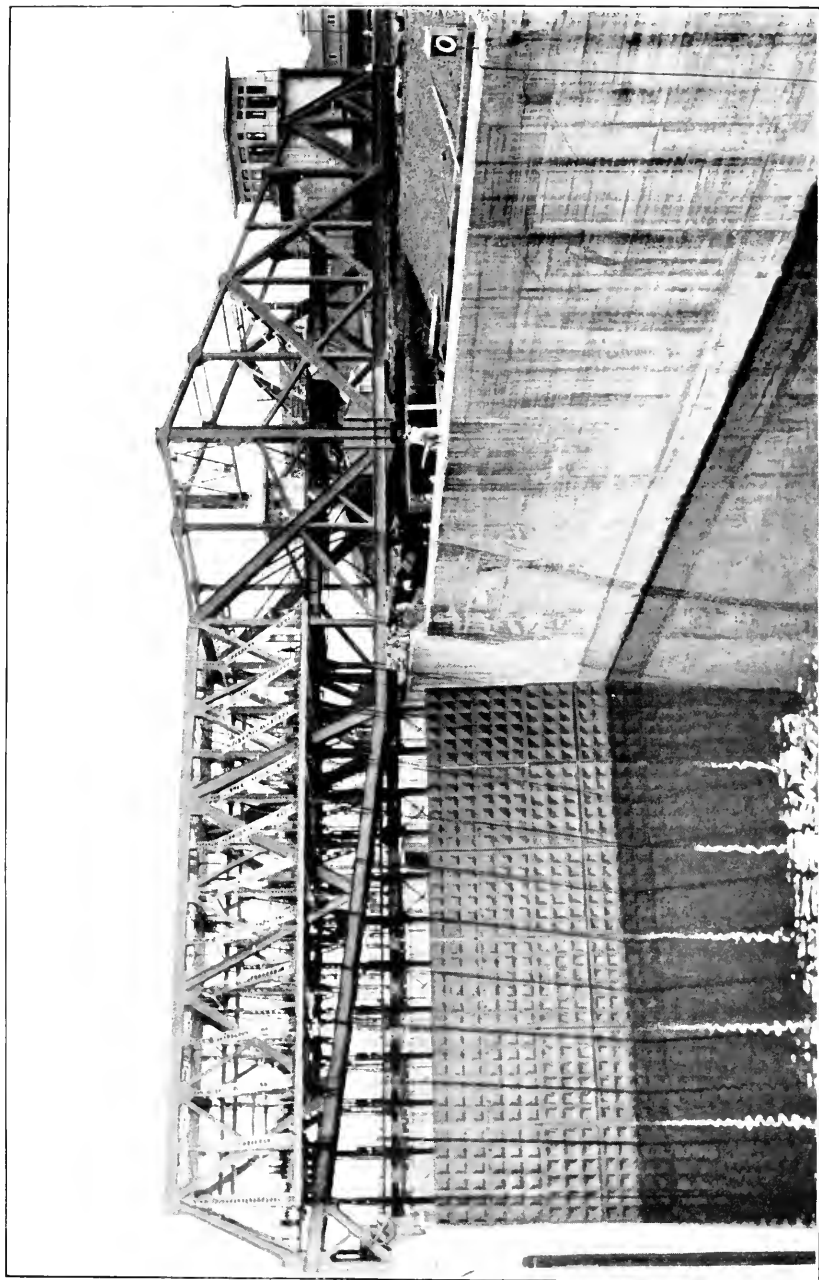
GATUN UPPER LOCKS. FINAL TEST OF EAST EMERGENCY DAM. DAM SWUNG ACROSS LOCK, AND WICKET GIRDERS BEING LOWERED. MAY 20, 1913.





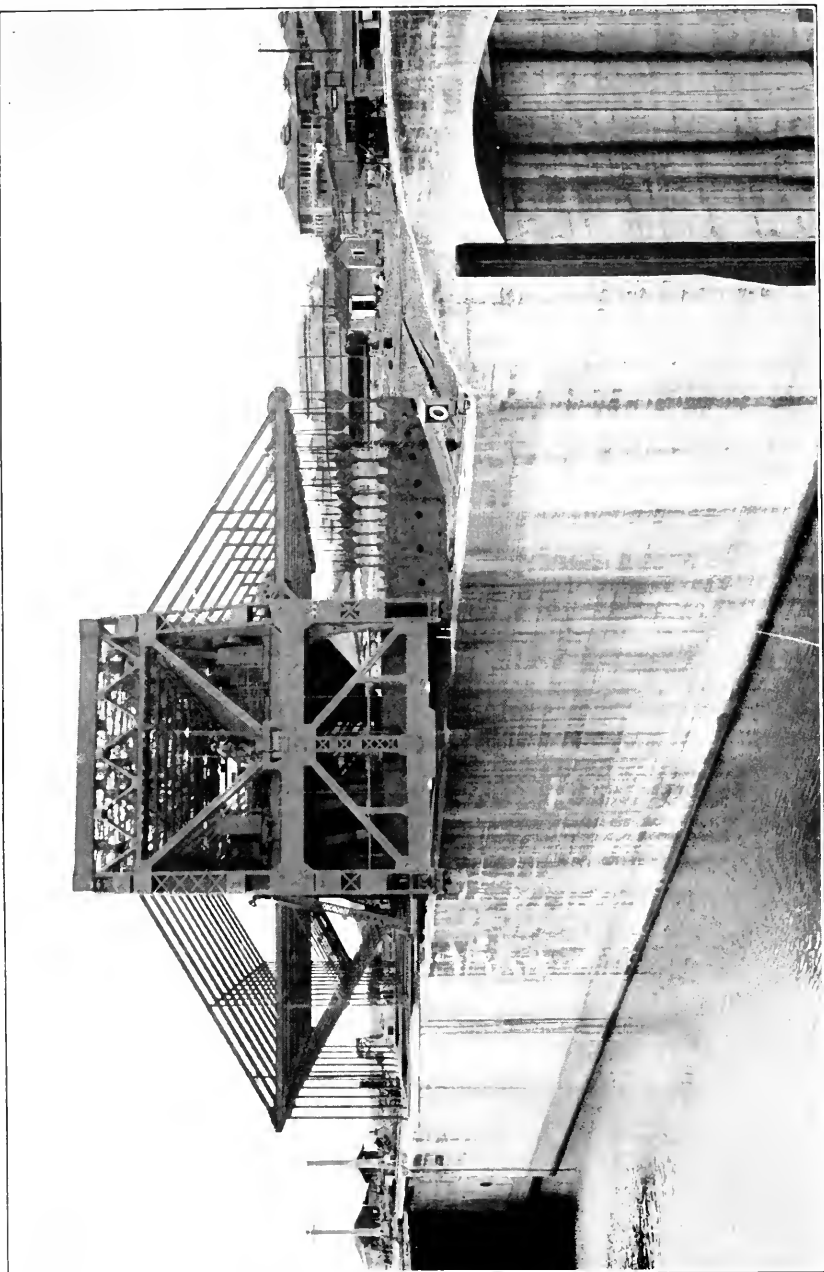
GATUN UPPER LOCKS. FINAL TEST OF EAST EMERGENCY DAM. DAM SWUNG ACROSS LOCK, AND THIRD HORIZONTAL TIER OF GATES BEING LOWERED. MAY 20, 1913.





GATUN UPPER LOCKS. FINAL TEST OF EAST EMERGENCY DAM. DAM IN CLOSED POSITION ACROSS LOCK. MAY 20, 1913.

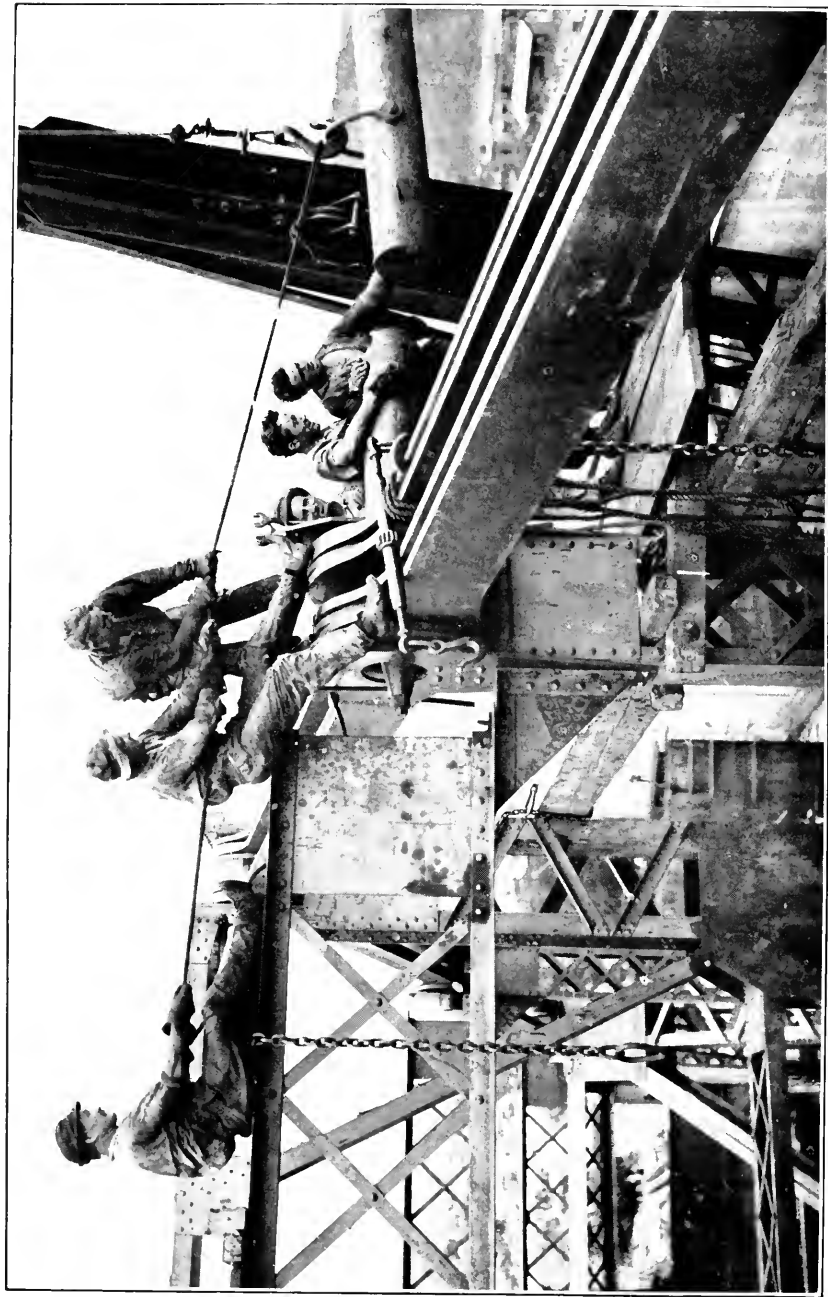




GATUN UPPER LOCKS. EAST EMERGENCY DAM IN ACT OF SWINGING ACROSS LOCK. JUNE 20, 1913.

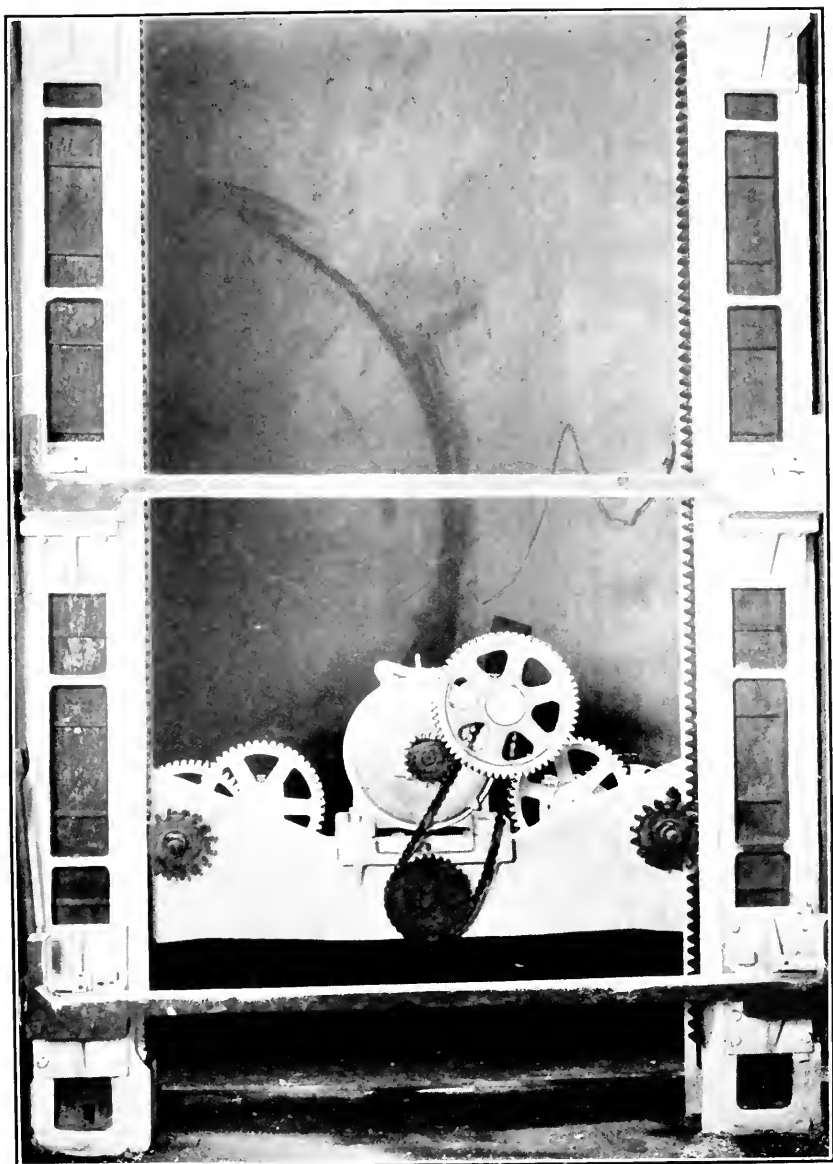






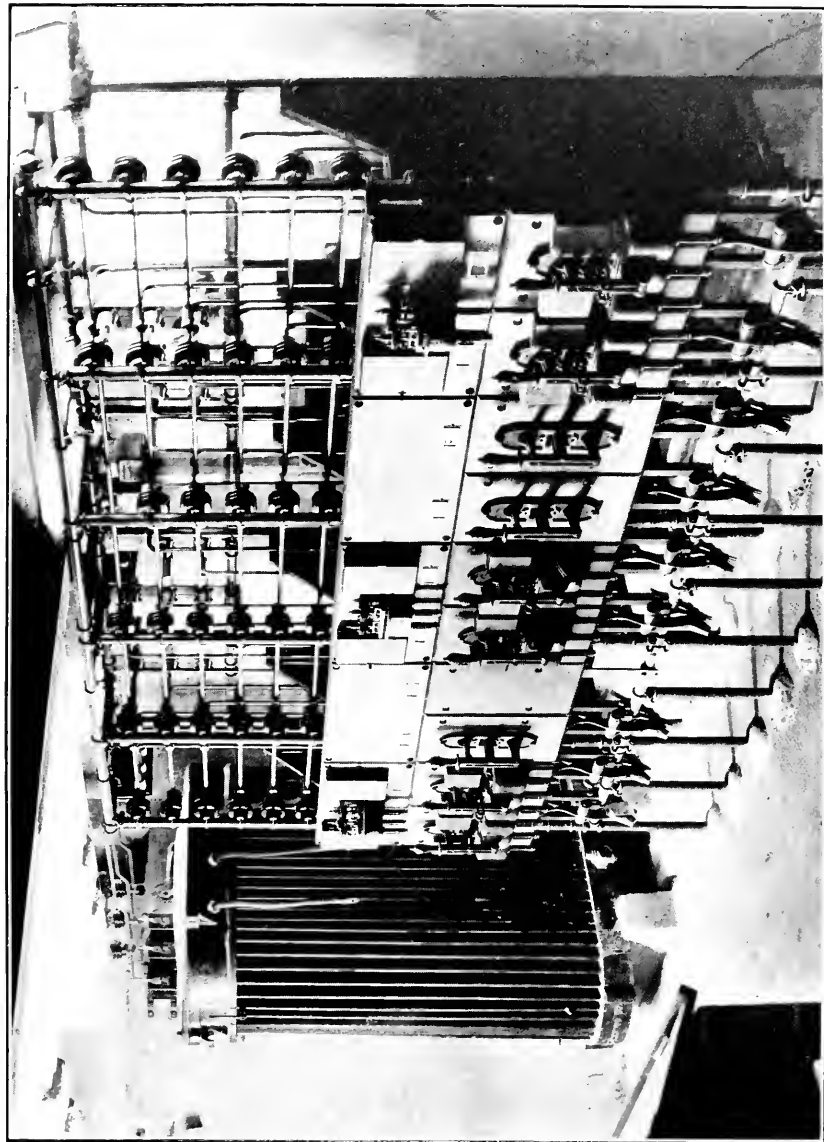
PEDRO MIGUEL LOCK. EAST EMERGENCY DAM. DRIVING PIN FOR EYE BAR OF TOP CHORD. MAY 2, 1913.





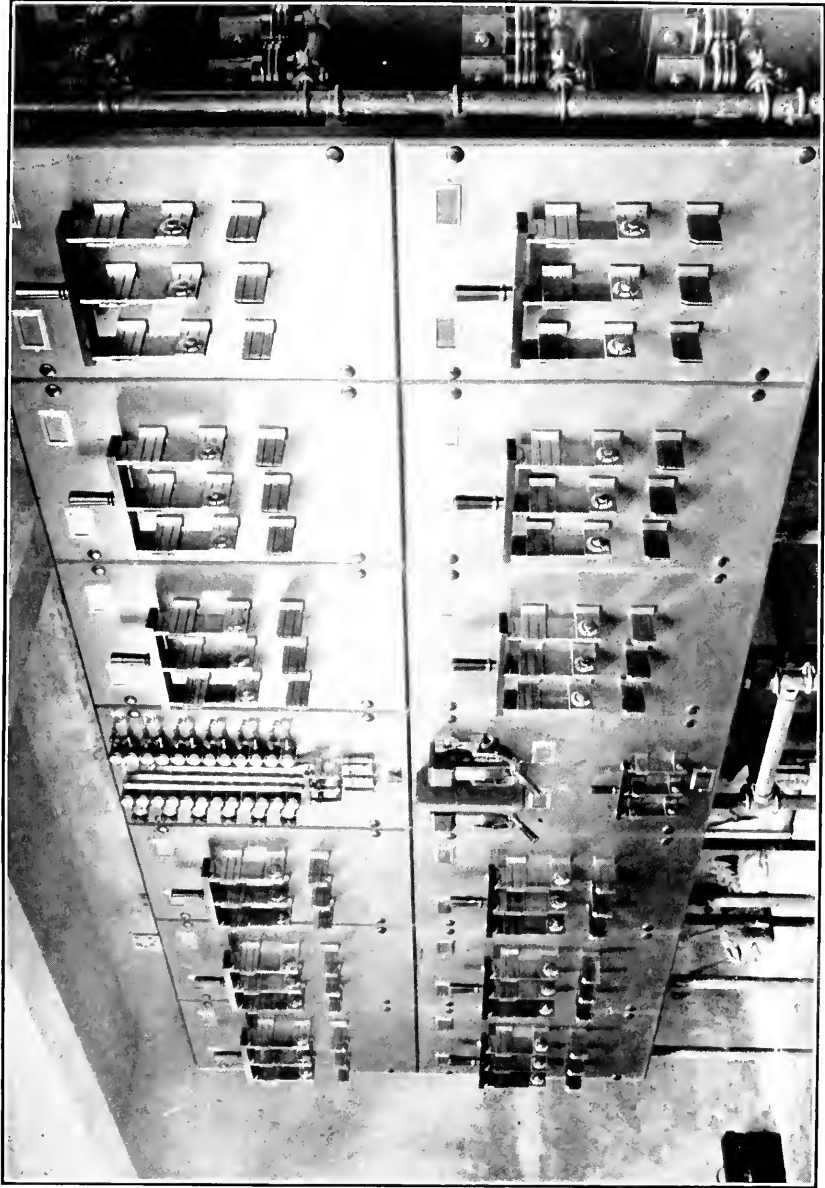
SPECIAL MILLING MACHINE FOR CORRECTING FIXED IRONS OF RISING STEM VALVES. MIRAFLORES LOWER LOCK, EAST WALL, LOOKING UPSTREAM.





HIGH TENSION OIL SWITCH GROUP, TRANSFORMER ROOM EQUIPMENT. PEDRO MIGUEL LOCK.

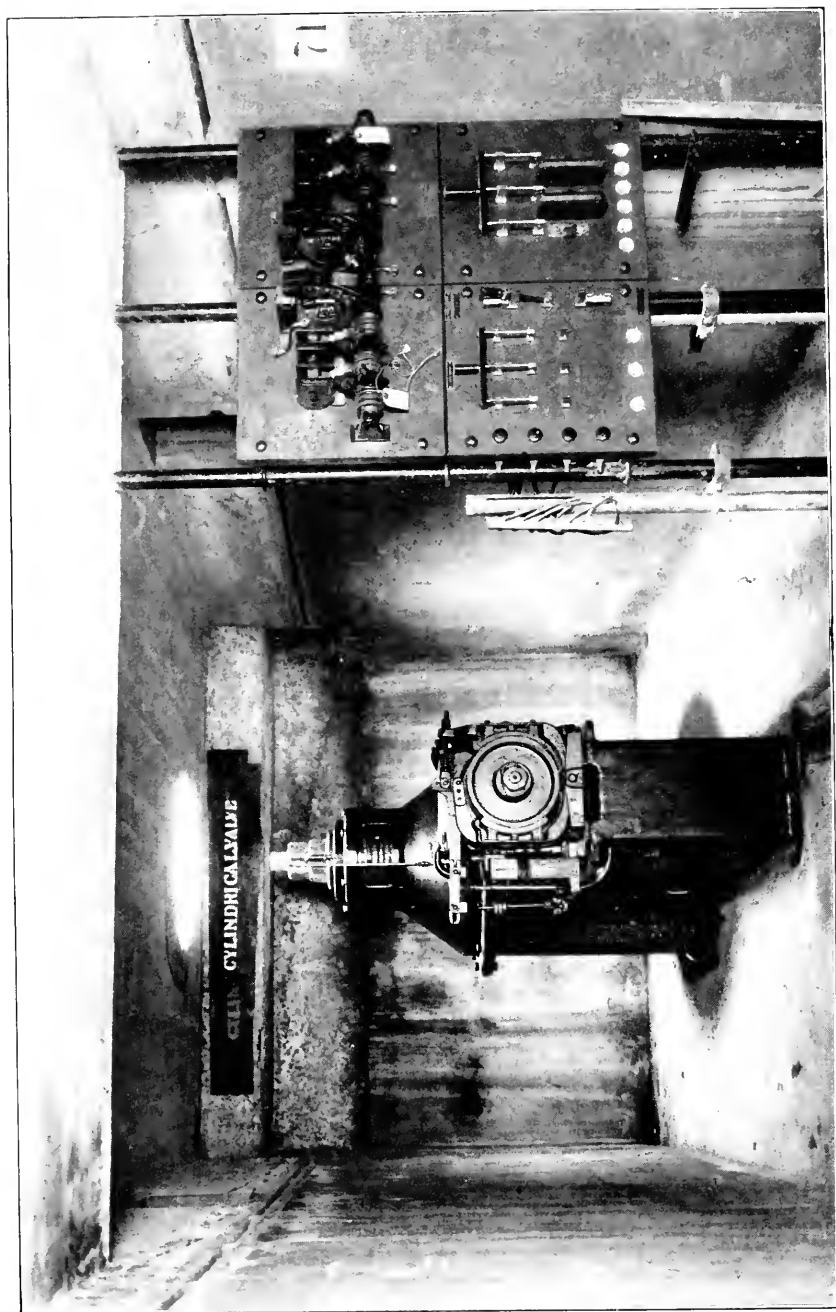




LOW TENSION SWITCHBOARD, TRANSFORMER ROOM EQUIPMENT. MIRAFLORES LOWER LOCK.







CYLINDRICAL VALVE MACHINE NO. 717, AND CONTROL PANEL. MIDDLE WALL, UPPER LOCKS, MIRAFLORES, CHAMBER WALLS, FLOOR AND PANEL PARTIALLY COMPLETED. JUNE 20, 1913.





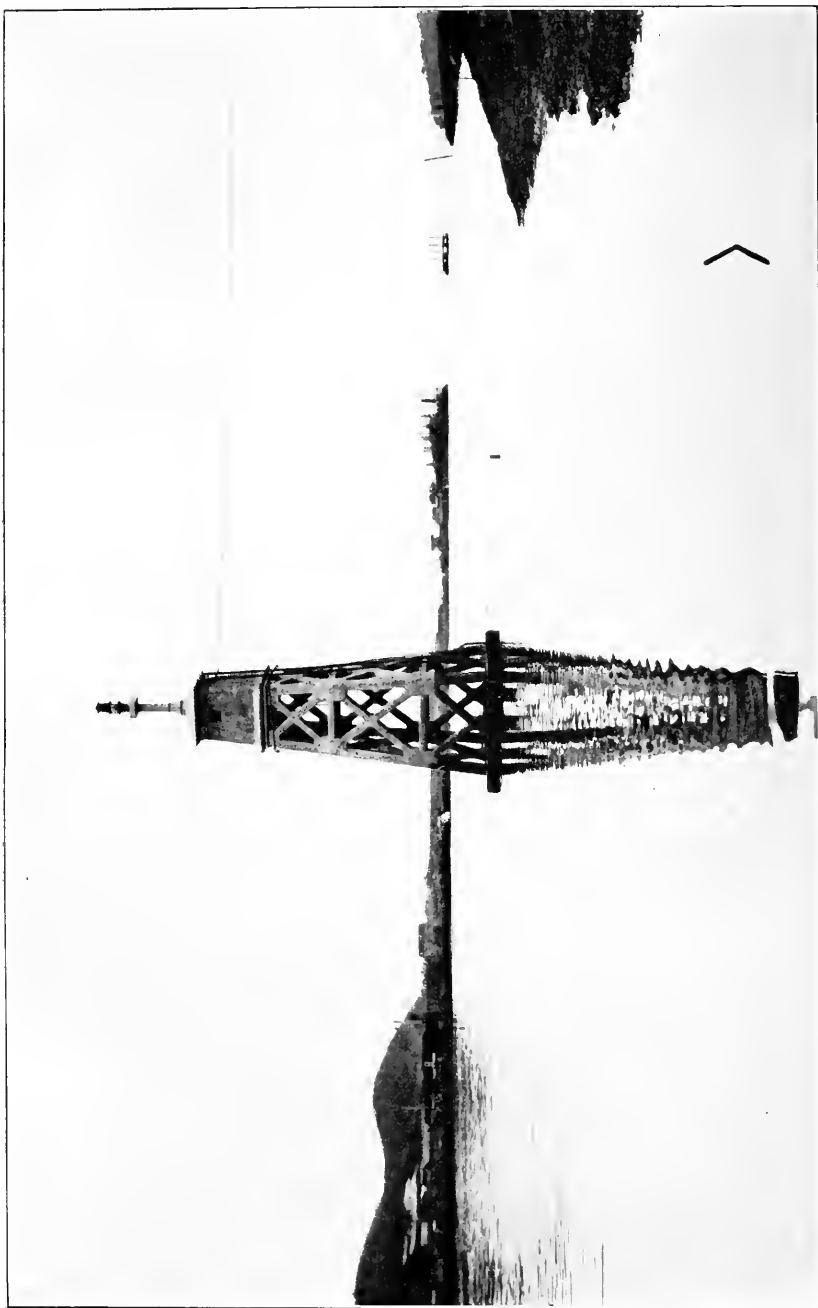
RANGE TOWER NO. 17, GATUN LAKE SECTION, SHOWING SUBMARINE FOUNDATION.





RANGE TOWER NO. 18, GATUN LAKE SECTION.

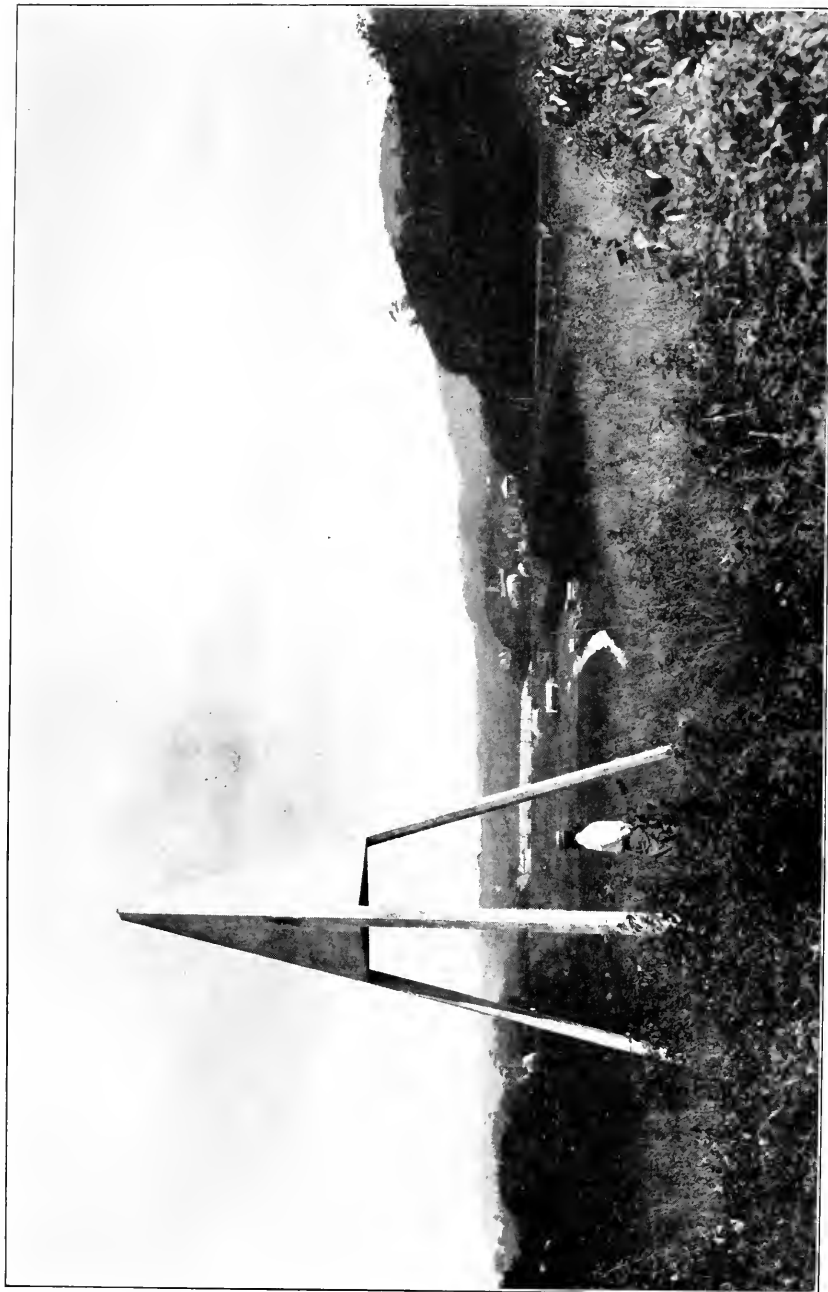




BEACON NO. 5, PACIFIC DIVISION. TYPICAL CONCRETE BEACON MARKING LIMITS OF CHANNEL BETWEEN BALBOA AND MIRAFLORES. PHOTOGRAPH TAKEN AT ABOUT MEAN TIDE.







TYPICAL UNLIGHTED BEACON, TWO OF WHICH FORM A RANGE MARKING THE AXES OF THE SHORTER TANGENTS IN GATUN LAKE.



## APPENDIX B.

### REPORT OF LIEUT. COL. WILLIAM L. SIBERT, CORPS OF ENGINEERS, UNITED STATES ARMY, MEMBER OF ISTHMIAN CANAL COMMISSION, DIVISION ENGINEER, ATLANTIC DIVISION.

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ISTHMIAN CANAL COMMISSION,  
DEPARTMENT OF CONSTRUCTION AND ENGINEERING,  
ATLANTIC DIVISION, OFFICE OF THE DIVISION ENGINEER,  
*Gatun, Canal Zone, July 31, 1913.*

SIR: I have the honor to submit the following report of work done by the Atlantic division, department of construction and engineering, during the fiscal year ending June 30, 1913:

The work assigned to the division remains as described in the report for the fiscal year ending June 30, 1910, with the exception that the work of excavating the channel between the Gatun Locks and the Atlantic Ocean was transferred to the sixth division of the chief engineer's office on May 1, 1913, and the dry dock and its shops to the mechanical division on the same date.

The construction work comprised within the division is shown on the accompanying drawing 12-14-40 (plate No. 88), and is divided into four parts as follows:

First. That comprising procuring and transporting stone from Porto Beño; the construction of the west breakwater in Colon Harbor, and the transportation of cement from Cristobal to Gatun; Lieut. Col. Chester Harding, Corps of Engineers, United States Army, assistant division engineer, in local charge until February 27, 1913; Lieut. Col. William V. Judson, Corps of Engineers, United States Army, assistant division engineer, in local charge from March 8, 1913, until June 30, 1913.

Second. That comprising the construction of the Gatun Locks, with the exception of the installation of the gates and machinery, Maj. James P. Jervey, Corps of Engineers, United States Army, resident engineer, in local charge.

Third. That comprising the construction of the Gatun Dam and spillway, Maj. George M. Hoffman, Corps of Engineers, United States Army, resident engineer, in local charge.

Fourth. That comprising municipal engineering work, Mr. Geo. M. Wells, office engineer, in local charge.

#### DIVISION OFFICE.

The usual clerical duties were performed in connection with miscellaneous correspondence, reports, cost accounting, pay rolls, property accounting, and other routine papers. The timekeeping work

of the division was transferred to the office of the examiner of accounts on April 1, 1913. The cost accounting work was transferred to the office of the cost-keeping accountant on the same date.

### DIVISION DESIGNING FORCE.

[Mr. George M. Wells, office engineer, in local charge.]

The following is a summary of the work done by the division designing force during the fiscal year:

Preparation of drawings to accompany the annual report of the division engineer for the fiscal year 1912-13.

Studies for permanent dock in Gatun Lake immediately west of the Panama Railroad station.

Classification of materials in the Gatun Dam.

Studies for the finished slopes and drainage of terreplein adjacent to the lock walls.

Progress plans and sections of the Gatun Dam.

Construction details of walls and excavation of the north forebay.

Detailed drawings of 66-foot lead-skid pile drivers.

Construction details for 10-foot, 15-foot, and 20-foot highway bridge spans.

Seventy-five drawings showing construction details for the new Colon waterworks.

Details of gravel washing and separating plant.

Computations for adjustment of costs for the Colon improvements.

Details of construction for new gate house, Brazos Brook.

Details of construction of 30-foot span concrete footbridge across the Brazos Brook spillway.

Details of construction of 10,000-gallon concrete wash-water tank at Agua Clara filtration plant.

Details of construction for building containing Gatun Lake-Brazos Brook controlling apparatus.

Miscellaneous details of spare and repair parts for miscellaneous plant.

Studies and preliminary drawings for structures involved in the proposed new waterworks for the southern end of the Panama Canal.

During the year approximately 6,500 blue prints were made.

### WEST BREAKWATER QUARRY.

[Lieut. Col. Chester Harding, Corps of Engineers, United States Army, assistant division engineer, in local charge until February 27, 1913. Lieut. Col. William V. Judson, Corps of Engineers, United States Army, assistant division engineer, in local charge from March 8, 1913, until June 30, 1913.]

The breakwater quarry at Porto Bello was originally being developed in two benches, each to have a breast of at least 60 feet at the highest point and an approximate length of 1,700 feet, but on account of the peculiar formation of the hill it was found there would not be rock enough on the two lower benches to complete the breakwater. The development of the two lower benches was, therefore, temporarily suspended, and in November, 1912, operations were commenced on the old crushed-rock quarry level, above the two benches last mentioned, when one shovel was placed there, and after the first of the year two more were added. It is expected that by September 1, 1913,

the remainder of the armor rock can be secured from the two lower levels.

On August 5, 1912, broad-gauge equipment was placed in service, and in October, 1912, the output was increased from two to three barges per day.

The equipment in service at this station for the producing of armor rock includes three 91-ton Marion steam shovels, one 70-ton Bucyrus steam shovel, two 300-class locomotives, seven 400-class locomotives, one 500-class locomotive, four locomotive cranes, and one 70-ton steam shovel converted into a crane, unloader, plow, and spreader, and 62 Lidgerwood flat cars.

The following is a detailed statement of the work done at Porto Bello, and the cost, by months, for the fiscal year ending June 30, 1913:

Month.	Monthly output.	Unit cost per cubic yard, solid measurement.		
		Operation.	Plant.	Total.
1912.		<i>Cu. yds.</i>		
July.....	8,678	\$2.9141	\$0.3010	\$3.2151
August.....	9,332	3.1975	.3010	3.4985
September.....	8,711	3.2957	.3010	3.5967
October.....	14,313	2.3755	.3010	2.6765
November.....	12,389	2.3490	.3010	2.6500
December.....	16,034	2.0899	.3010	2.3909
1913.				
January.....	18,383	2.2395	.3320	2.5715
February.....	17,633	1.9106	.3320	2.2426
March.....	19,321	1.9954	.3320	2.3274
April.....	19,515	2.3696	.3320	2.7016
May.....	19,772	2.1141	.3320	2.4461
June.....	19,681	2.4362	.3320	2.7682

Average cost of armor rock per ton for the year, \$1.1939.

About 60 per cent of quarry output is wasted in procuring pieces of suitable size.

#### WATER TRANSPORTATION.

In connection with this service the plant steamed about 24,250 miles, handled about 1,650 barges, and carried approximately 22,500 passengers.

From March 1, 1913, to May 22, 1913, about 3,220,000 gallons of water were hauled from Mindi to Toro Point.

Regularly employed in the transportation service are one tug and seven stone barges, while others are available in case of breakdown or necessity for repairs.

#### WEST BREAKWATER, COLON.

During the year 599 linear feet of single-track trestle were built, the total length of double or single trestle being now 11,526 feet.

The total amount of Porto Bello armor rock placed on the breakwater was 183,762 cubic yards, of which 102,508 cubic yards were removed from barges to Lidgerwood cars by locomotive cranes and plowed off. The balance was placed by derrick barges, and by self-

dumping barge (225 yards). At the end of the fiscal year 248,895 cubic yards of armor rock were in place. About 220,433 cubic yards of dredged rock were dumped on the breakwater.

For more than half the length of the breakwater the sea slope is completed, and the armor is well above the water surface from end to end, not including the ell.

A small pile wharf was built for the handling of rock by cranes, and 3,000 cubic yards of sand were dredged by derrick barge for the barge berth.

The usual maintenance work was done on pipe lines, reservoir, and sewers.

The plant in service includes 3 locomotive cranes, 2 locomotives, 16 Lidgerwood cars, 1 unloader, 1 plow, 1 pile driver, and 2 derrick barges. A third derrick barge is approaching completion.

The following table shows details of costs of quarry operation, water transportation, and placing of large rock in the breakwater:

*Comparative statement—Porto Bello large rock.*

	1912					
	July.	August.	September.	October.	November.	December.
Quarrying:						
Stripping.....	\$0.7505	\$0.5348	\$0.7437	\$0.4649	\$0.5729	\$0.3588
Drilling.....	.1841	.1521	.1817	.1287	.1298	.0794
Blasting.....	.3739	.3145	.3929	.2255	.3063	.2241
Loading.....	.1888	.1804	.1723	.1064	.1182	.1114
Transportation.....	.1833	.2009	.1391	.0978	.1105	.1223
Tracks.....	.4540	.4756	.0818	.4037	.4287	.3418
Loading on barges.....	.1848	.2791	.7127	.1621	.1787	.1572
Power.....	.1919	.1755	.1891	.1256	.0930	.1194
Maintenance of equipment	.4028	.5846	.6824	.6608	.4109	.5755
Plant arbitrary.....	.3010	.3010	.3010	.3010	.3010	.3010
Total.....	3.2151	3.4985	3.5967	2.6765	2.6500	2.3909
Towing:						
Operation tugs and barges	.6324	.3720	.4687	.3089	.3405	.2504
Maintenance of equipment	.2731	.2153	.2189	.3664	.4454	.1372
Plant arbitrary.....	.4040	.4040	.4040	.4040	.4040	.4040
Total.....	1.3095	.9913	1.0916	1.0793	1.1899	.7916
Placing large rock — Toro Point:						
Operation floating derricks.....	.7593	.6639	.5583	.2915	.3708	.2614
Maintenance floating derricks.....	.0966	.1707	.1679	.4913	.1490	.0904
Operation cranes on dock.....	.2506	.3429	.3778	.2755	.2850	.2569
Operation trains.....	.1175	.2048	.1798	.1324	.1710	.1390
Dumping.....	.1253	.0349	.0327	.0274	.0218	.0161
Maintenance of equipment	.2658	.2875	.4411	.4570	.2738	.3343
Plant arbitrary.....	.1641	.1640	.1640	.1640	.1640	.1640
Total.....	.9496	1.0161	1.0392	.9936	.8156	.7382
Division expense.....	.3490	.3303	.3161	.3271	.3191	.1938
	5.8232	5.8362	6.0436	5.0765	4.9746	4.1145
Miscellaneous tug service.....		.2006	.1569	.0854	.1545	.0833
Maintenance, equipment, miscellaneous.....		.0390	.0569	.0765	.1079	.0411
Trestles.....	.7612	.3911	.2293	.2412	.1934	.1680
Administration and general expense.....	.4688	.6340	.6422	.2106	.5208	.4021
Total.....	7.0532	7.1009	7.1289	5.6902	5.9512	4.8090
Output (cubic yards).....	8,678	9,332	8,711	14,313	12,389	16,034

*Comparative statement—Porto Bello large rock—Continued.*

	1913					
	January.	February.	March.	April.	May.	June.
Quarrying:						
Stripping.....	\$0.2955	\$0.3179	\$0.3327	\$0.3562	\$0.3363	\$0.4177
Drilling.....	.1026	.1370	.0907	.0814	.0514	.1014
Blasting.....	.2440	.2375	.1674	.1468	.2034	.1266
Loading.....	.1249	.1111	.1301	.1104	.1270	.1246
Transportation.....	.1385	.1294	.1580	.1271	.1658	.1613
Tracks.....	.2170	.2436	.3756	.4831	.4736	.3714
Loading on barges.....	.1365	.1475	.1480	.1521	.1599	.2225
Power.....	.1182	.1233	.0918	.1144	.1156	.1344
Maintenance of equipment.....	.8623	.4633	.5011	.7981	.4811	.7763
Plant arbitrary.....	.3320	.3320	.3320	.3320	.3320	.3320
Total.....	2.5715	2.2426	2.3274	2.7016	2.4461	2.7682
Towing:						
Operation tugs and barges.....	.1599	.2912	.1573	.2907	.2883	.2558
Maintenance of equipment.....	.0570	.2516	.0681	.1456	.0420	.1797
Plant arbitrary.....	.3840	.3840	.3840	.3840	.3840	.3840
Total.....	.6009	.9268	.6094	.8203	.7143	.8195
Placing large rock — Toro Point:						
Operation floating derricks.....	.3750	.3369	.2976	.3779	.3970	.3692
Maintenance floating derricks.....	.0473	.1435	.4954	.3668	.0316	.2638
Operation cranes on dock.....	.2304	.2487	.2680	.2733	.3354	.3242
Operation trains.....	.1220	.1260	.1241	.1164	.1391	.0923
Dumping.....	.0133	.0101	.0124	.0138	.0277	.0261
Maintenance of equipment.....	.2142	.3206	.1284	.1642	.2152	.2363
Plant arbitrary.....	.1500	.1500	.1500	.1500	.1500	.1500
Total.....	.6697	.7753	.7799	.7836	.6954	.8038
Division expense.....	.1487	.1400	.0897	.1658	.1553	.1900
	3.9908	4.0847	3.8064	4.4713	4.0110	4.5815
Miscellaneous tug service.....	.0782	.0620	.0499	.0522	.0593	.0409
Maintenance, equipment, miscellaneous.....	.0281	.0542	.0244	.0316	.0004	.0082
Trestles.....	.0823	.1110	.1236	.1081	.0732	.1008
Administration and general expense.....	.3855	.4244	.3748	.4208	.3464	.3137
Total.....	4.5649	4.7363	4.3791	5.0840	4.4904	5.0451
Output (cubic yards).....	18,383	17,633	19,321	19,515	19,772	19,681

<sup>1</sup> Cost per solid yard of rock suitable for armoring breakwater, 60 per cent of rock handled wasted on account of size.

## GATUN LOCKS.

[Maj. James P. Jervey, Corps of Engineers, United States Army, resident engineer, in local charge.]

## EXCAVATION.

At the beginning of the fiscal year 1912-13 all excavation necessary for the construction of the locks proper had been completed, and the excavation north of the north caisson sills necessary for the construction of the flare walls and middle approach wall was well under way. As described in the report for the year 1911-12, this material was too soft to support steam shovels, and the work was done by dredges cut in from the sea-level section of the canal. During the fiscal year a total of 384,526 cubic yards was taken out at a cost of 47.09 cents per cubic yard. This cost, as previously stated, includes a proportional cost of the reenforced concrete dam at the north end of the locks, of the Mindi Levee, and of plant. A part of the material removed extended to a depth of 70 feet below sea level, and as the dredges

could only excavate to a depth of 41 feet, it was necessary to lower the level of the pool in which floated the dredges in order to complete the excavation. This lowering of the pool level was accomplished by building a clay dam across the channel through which the dredges had entered the excavation pit, and then lowering the water by pumping it out with the dredges. (See plate No. 89, showing plan of construction, north end of Gatun Locks.) The pool level was regulated by the discharge water from the regular pumping plant in the locks and by a supply furnished by an additional 12-inch pump which was installed near the east diversion. The excavation for the flare walls was extended behind such walls, as shown on plate referred to above, until the dredges encountered bedrock before the water was lowered sufficiently to cause the banks to slide.

This excavation was made wide enough for the flare walls, for a rock fill of sufficient width to act as a retaining wall as the water was lowered, and for the cableway tracks. A trestle, using shod piles, was driven into the soft rock from which the overlying mud had been dredged, and a rock fill paralleling the foundations of the flare walls was made from this trestle. As the dredges were lowered in order to complete the excavation, the rock fill was extended as fast as the underlying bedrock was uncovered. By this means all serious sliding into the excavation for the flare walls was prevented. The extreme depth to rock on the east side of the excavation prevented a continuation of this method for the approach wall. This latter wall was in the center of the excavation, where the dredges made a cut 140 feet wide at 55 feet below sea level. The side slopes, from this maximum depth, were stepped up on a 1 on 5 slope, in the hope that the banks would remain stable, it being intended to extend the cableway tracks for the full length of the north approach wall provided the banks were sufficiently firm to carry them. When the dredging was completed a slope of 1 on 13 existed in places on the east side of the excavation, and after the slide of January 25, 1913, at some points the slope was flattened to 1 on 20. The final dredging was completed in November, 1912, the dredges floating as low as 32 feet below sea level. The excavated space was then filled from the sea, the clay dam removed, a dipper dredge and one suction dredge taken out, and dredge *No. 83*, a pump barge, and two coal barges left inside the excavated space. The clay dam was then rebuilt and the final unwatering commenced. The dredge was successfully grounded without particular difficulty, at 55 feet below sea level. Two steam shovels were then put to work over that portion of the center wall foundation where rock appeared. These shovels also accomplished channel excavation on the west side where the material was sufficiently firm to support them. The channel excavation and preparing foundations were continued by shovel, crane, cableways, and by hand successfully, and the pile foundation for the approach wall was about half completed when, on January 25, 1913, the east bank gave way, at point marked "C" on plate No. 89, and a slide covered the greater part of the foundation for the approach wall with mud from 6 to 18 feet deep and destroyed two pile drivers. (See photograph, plate No. 19.) In order to remove this mud it was necessary to drive a pile trestle to rock for supporting a crane along the axis of the approach wall. The mud brought in by the slide was removed partly by crane, partly



by hand, and partly by sluicing and pumping with dredge *No. 83*. The entire foundation was finally cleared in March, 1913. This slide caused a delay of approximately six weeks in the completion of the north center approach wall, and rendered it impossible to utilize the cableways for the entire length of this wall.

#### PILING.

In order to drive the piles for the north approach wall, it was necessary to construct four turntable skid drivers with 60-foot leads. To assist in the construction of these drivers a guy derrick was erected on the center wall near the lower guard gates. The drivers were completed in December, 1912, and commenced work driving piles for the center approach wall. The four drivers continued work until January 25, 1913, when two of them were destroyed by the slide referred to above. The work of driving was delayed for four weeks and then resumed with the two skid drivers and one track driver. This work was completed in March, 1913. Five thousand piles, aggregating 200,549 linear feet, were driven at a total division cost of 55.04 cents per foot. In addition to the round piles, 5,657 feet of sheet piling were driven under the curtain wall which closes the first six spans of the north center approach wall.

#### CONCRETE WORK.

At the beginning of the fiscal year the total amount of concrete in place was 1,875,965 cubic yards. A recalculation of the amount to be placed by the Atlantic division increased the estimate to a total of 2,043,730 cubic yards. This increase was due to the fact that a continuous bottom slab was placed under the piers of the north center approach wall, and the north flare walls were carried to a lower level than expected. The total of 170,280 cubic yards of concrete which was mixed by mixer No. 1, portable mixers, and by hand was distributed as follows:

Placed in the locks proper (plain concrete)-----	137,218
Placed in the locks proper (reenforced concrete)-----	27,532
Used in the construction of lamp-posts, lamp-post bases, and snubbing-button bases-----	1,900
Placed in control house-----	568
Used for concrete paving of back fill between the upper locks and the Panama Railroad station-----	139
<hr/>	<hr/>
Total, Atlantic division work-----	167,357
Mixed concrete supplied to the first division-----	1,375
Supplied to first division for emergency dams-----	1,548
<hr/>	<hr/>
Total mixed by locks subdivision-----	170,280

The grand total placed by the locks subdivision and applying on locks masonry to the end of the fiscal year is 2,040,715 cubic yards.

In the summer of 1912 it was estimated that the concrete work for the Gatun Locks proper would be completed by July 1, 1913, provided there were no unforeseen delays. As previously stated, the slide of January 25, 1913, caused a delay of about six weeks. The concrete work, excepting miscellaneous finishing, was, however, completed on June 14, 1913. The concrete remaining to be placed at the close of the fiscal year consisted of a few lamp-post bases, snubbing-

button bases, mooring-post bases, stair-well parapets, paving, and the concrete necessary to close a few openings which have been left for construction purposes. In addition to this concrete, the Atlantic division is completing the concrete work for the first division connected with the towing and return tracks on the north center approach and north flare walls.

As the slide of January 25 rendered it impracticable to extend the cableway tracks north of the end of the north flare walls, it became necessary to devise auxiliary means for placing the concrete in the remainder of the north center approach wall. After considerable thought, it was decided to construct the bottom or foundation slab for this work by delivering the concrete with the cableways into a hopper placed at the bottom of the excavation. From this hopper the concrete was delivered into 4-yard Western dump cars, which were hauled out by steam locomotives over a narrow-gauge framed trestle, supported by the foundation piles, along the longitudinal axis of the wall. From this trestle the concrete was dumped to the east and west, completing approximately three-fourths of the foundation. The track was then shifted to the top of the completed concrete, the trestle was removed, and the remaining space in the center filled. The bottom slab was heavily reenforced with old French rails and unserviceable American rail. This reenforcement extended continuously, both longitudinally and transversely, through the foundation, a layer being placed near the top and another near the bottom of the slab. After a section of the bottom slab was completed, two locomotive cranes, with 70-foot wooden booms, which were designed and constructed at Gatun, were placed on a standard gauge track laid along the longitudinal axis of the wall, on the foundation slab. As the lower portions of the piers consisted of detached parts, each 10 feet by 18 feet in cross section, connected at the top by a full-centered arch, it was possible to run these cranes freely up and down for the full length of the wall. The long booms of the cranes rendered possible the construction of the piers to full height in an economical and rapid manner.

After the completion of the piers one of the same cranes was used for placing the steel girders which support the decking for the towing and return tracks. The heaviest of these girders exceed 5 tons in weight. (See photograph, plate No. 20.)

The decking, as far north as the end of the flare walls, was placed directly by the cableways. Beyond the limits which could be reached by the cableways, it was placed with narrow-gauge steam equipment in a manner similar to that used in the construction of the foundation slab, the tracks being supported on the permanent girders. The use of two small electric hoists, designed and constructed by the locks forces and driven by  $7\frac{1}{2}$  horsepower motors taken from the automatic cars, greatly expedited and cheapened the placing of the heavy timbers for supporting the decking forms.

The average division cost for the year, for taking concrete material from storage, mixing, and placing in the lock walls, including plant charge, has been as follows:

	Cost per cubic yard.
Forms-----	\$0. 8416
Mixing-----	. 2399
Placing and finishing-----	. 5847

	Cost per cubic yard.
Reinforcement.....	\$0.0075
Pumps.....	.0814
Power.....	.0697
Maintenance of equipment.....	.2144
Plant arbitrary.....	.7730
Division expense.....	.1382

Total..... 2.9504

Mixing includes a haul of 2,000 feet and a lift of 63 feet for practically all of the concrete placed.

Attached are given comparative costs of concrete for the year.

It may be noted that the entire cost of the transportation plant, unloading plant, concrete mixing and placing plant, has been absorbed and charged against the construction of the Gatun Locks.

*Comparative statement of costs—Locks masonry.*

MASS.

	1912					
	July.	August.	September.	October.	November.	December.
Concrete (cubic yards).....	3,735	3,222	1,926	2,685	5,114	4,043
Cement.....	\$2.1120	\$1.9304	\$1.5537	\$1.3733	\$1.3265	\$1.3884
Stone.....	1.7641	1.8648	1.5759	1.2810	1.5921	1.8371
Sand.....	.6832	.6920	.6947	.5995	.5781	.6308
Wood forms.....	.5499	.9035	1.2632	1.6778	2.5876	1.8776
Steel forms.....	<b>.1542</b>					
Mixing.....	.3696	.3327	.6469	.8430	.6144	.6768
Placing.....	.9324	.5764	2.2071	1.3668	.8366	.8408
Finishing.....	.2082	<b>.0366</b>	.2178	.3069	.1891	.4246
Reinforcements.....						
Pumps.....	.0763	.0719	.1513	.1130	.1187	.5059
Power.....	.0820	.0840	.2233	.1892	.1181	.1824
Maintenance of equipment.....	.2755	.2463	.6020	.7312	.5506	.0360
Plant arbitrary.....	.9380	.9377	.9380	.9380	.9380	.9380
Division expense.....	.2104	.3468	.4126	.5529	.3971	.2196
Total division cost.....	8.0474	7.9499	10.4865	9.9726	9.8469	9.5580
Administration and general expense.....	.4748	.8629	1.1570	1.9543	1.1801	.8510
Total cost.....	8.5222	8.8128	11.6435	11.9269	11.0270	10.4090

	1913					
	January.	February.	March.	April.	May.	June.
Concrete (cubic yards).....	28,689	30,680	33,424	18,501	5,634	96
Cement.....	\$1.2807	\$1.3192	\$1.2612	\$1.2437	\$1.2160	\$1.9532
Stone.....	1.9956	2.0328	1.4369	1.6802	1.5301	.7406
Sand.....	.6110	.6205	.3770	.3011	.2756	.2850
Wood forms.....	.5527	.6487	.6386	.9911	1.3349	9.0955
Steel forms.....			<b>.0016</b>			
Mixing.....	.1248	.1707	.1594	.2608	.3901	.3987
Placing.....	.2905	.2777	.2985	.6676	.8561	1.3762
Finishing.....	.0689	.0728	.0720	.1001	.2161	12.4418
Reinforcements.....	.0084	.0017	.0201	.0035		
Pumps.....	.0616	.0460	.0584	.0523	.2381	.0996
Power.....	.0623	.0477	.0458	.0661	.1087	1.3464
Maintenance of equipment.....	.1732	.1629	.1641	.3025	.1741	<b>4.1485</b>
Plant arbitrary.....	.9380	.9380	.9380			
Division expense.....	.0796	.0700	.0616	.1818	.3263	2.5654
Total division cost.....	6.2473	6.4087	5.5300	5.8508	6.6661	26.1539
Administration and general expense.....	.2696	.2072	.2640	.3244	.7734	.4273
Total cost.....	6.5169	6.6159	5.7940	6.1752	7.4395	26.5812

*Comparative statement of costs—Locks masonry—Continued.*

## REENFORCED.

	1912					
	July.	August.	September.	October.	November.	December.
Concrete placed (cubic yards).	4,358	4,164	1,236	567	915	1,049
Cement.....	\$2.2758	\$2.2476	\$2.2391	\$1.6114	\$1.5117	\$2.1506
Stone.....	2.2910	1.9081	1.4552	1.2774	1.1808	.9508
Sand.....	.6678	.5728	.5897	.6594	.5647	.6187
Mixing.....	.5124	.4608	.4735	1.4188	.8602	.7976
Wood forms.....	2.4981	2.4280	2.7802	7.5541	3.4310	3.6257
Steel forms.....	.0137	.0019	.....	.....	.....	.....
Placing.....	1.0726	.9663	1.9922	2.5873	2.3539	3.2531
Reenforcements.....	.7113	.3570	1.2592	2.3664	.0372	.0193
Power.....	.1272	.1202	.0495	.2573	.1340	.1579
Maintenance of equipment.....	.3199	.2858	.3781	1.1458	1.0072	.7013
Plant arbitrary.....	.9380	.9382	.9380	.9380	.9380	.9380
Division expense.....	.4621	.3584	.4951	1.3472	.4876	.6706
Total division cost.....	11.8899	10.6451	12.6498	21.1631	12.5063	13.8836
Administration and general expense.....	.9891	1.0727	1.4407	3.3904	1.2886	2.1579
Total cost.....	12.8790	11.7178	14.0905	24.5535	13.7949	16.0415

	1913					
	January.	February.	March.	April.	May.	June.
Concrete placed (cubic yards).	101	.....	1,504	2,466	6,390	4,782
Cement.....	\$1.8812	.....	\$1.3049	\$1.8704	\$1.8750	\$1.8734
Stone.....	.3285	.....	1.4068	1.6663	1.5295	.7441
Sand.....	.6096	.....	.3969	.2997	.2760	.2864
Mixing.....	1.5229	.....	.1078	1.1571	1.1797	.2697
Wood forms.....	43.2581	.....	2.1337	5.5931	3.3832	2.0708
Steel forms.....	.2247	.....	.....	.....	.....	.....
Placing.....	6.3826	.....	.4802	.8878	.5960	.5471
Reenforcements.....	1.4572	.....	2.0600	.7156	.3590	.0536
Power.....	.3224	.....	.0101	.0146	.0091	.1646
Chipping.....	.....	.....	.5303	.2013	.0418	.0002
Maintenance of equipment.....	.7654	.....	.5247	.1398	.2451	.2088
Plant arbitrary.....	.9380	.....	.9380	.....	.....	.....
Division expense.....	2.0437	.....	.2198	.3363	.3020	.3404
Total division cost.....	56.2391	.....	10.1132	11.8820	8.7964	6.5591
Administration and general expense.....	5.6483	.....	1.0669	1.3838	.8169	.9781
Total cost.....	61.8874	.....	11.1801	13.2658	9.6133	7.5372

## CONCRETE MATERIAL.

During the year a total of 171,866 cubic yards of crushed stone was issued from the storage pile. Forty-three thousand eight hundred and fifty-one cubic yards of sand were unloaded on the storage pile. and 85,452 cubic yards were issued for concrete. Two hundred and twenty-five thousand barrels of cement in bags have been received and 227,000 barrels issued.

## UNLOADING PLANT.

During the year the unloading cableways have been used principally for reclaiming sand and rock for concrete purposes and for loading rock for sale to outside parties. The sand supplied from suction dredge, amounting to 10,883 cubic yards, was handled by the cableways from barges and placed in storage pile.

## HANDLING AND MIXING PLANT.

The handling and mixing plants have been operated satisfactorily during the year. The automatic railroad has handled 301,381.08 tons of material and the industrial railway 331,188 tons. Mixing plant No. 1 has mixed a total of 165,594 cubic yards of concrete. In addition to the concrete mixed in plant No. 1 there were mixed by portable mixer 2,742 yards and by hand 1,944 yards, making a total of 170,280 cubic yards of concrete mixed by the locks subdivision.

## GATE ERECTION.

The work of the Atlantic division in connection with the gate erection consisted in setting the fixed steel for the sills, quoins, and anchorages and in preparing the necessary storage grounds, erection tracks, etc., for the erection of the gates. The tracks connected with the gate construction have been kept in repair during the year.

## FIXED STEEL.

The erection of fixed steel during the year included the placing of material for Stoney gate valves, snubbing posts, anchorage bolts, and steel girders, towing and return tracks, etc. A total of 2,446½ tons of fixed steel has been placed at a cost of \$16.0204 per ton. All Stoney gate valves have been turned over to the first division for installation of the machinery.

## BACK FILL.

Back filling behind the side walls of all locks and in the center wall of the lower lock has been continued during the year. The back fill in all center walls has been completed. That on the east side walls is practically completed, but the west back fill can not be entirely completed until the concrete mixing plant and the incline leading thereto have been removed. In connection with the back-fill work a total of 637,226 cubic yards of material was removed by steam shovel from borrow pits and from the canal prism. All of this material was placed in the back fill with the exception of small quantities used from time to time for construction tracks. A total of 2,027,830 cubic yards, at an average cost of 50.40 cents per cubic yard, has been placed behind the side walls up to June 30, 1913, and a total of 113,163 cubic yards has been placed in the center walls, at a cost of 81.08 cents per cubic yard. In addition, 5,500 cubic yards excavated by dredge No. 4 were dumped as back fill.

The work of bringing the back fill to final grade was commenced in the month of March, 1913, by teams and scrapers and continued to the end of the fiscal year. Grading for the proposed wagon road on the east back fill was commenced early in June by crane and scraper and continued to the end of the month. About 1,500 cubic yards of material were excavated by this method and placed at other points on the back fill.

The concrete paving of the slope on the fill between the Panama Railroad station and the east wall of the upper locks was commenced on June 24, and 125 square yards of surface had been finished up to June 30. The paving of this slope consists of a layer of heavy riprap

rock 12 feet wide at the bottom, and above the elevation of this rip-rap a 6-inch concrete pavement resting on 4 to 6 inches of broken stone. A locomotive crane, equipped with a long boom, is utilized to place the concrete from track at the crest of the slope.

#### MISCELLANEOUS WORK.

Two hundred and eighty-four thousand seven hundred and eighty-four and one-half linear feet of tile duct were laid at a cost of 11.77 cents per foot.

Four hundred and thirty-three thousand seven hundred and thirty-seven linear feet of reenforcing rods and 683 tons of old rails were used for reenforcing concrete.

Four thousand three hundred and fifty-eight linear feet of return track were constructed.

Two thousand four hundred and thirty linear feet of buffer timbers were placed.

Two hundred and eleven lamp standards and bases were manufactured at a cost of \$149.4299 per lamp-post. This cost, however, includes a part of the cost of erection, as the majority of the lamp-post bases and foundations for these bases were constructed by the Atlantic division in place.

#### CONTROL HOUSE.

The construction of the control house for the Gatun Locks was started in April, 1913. The concrete for this building is being mixed in a small portable mixer, and is lifted to the upper elevation by an electric hoist and then distributed horizontally by Decauville cars. On July 1 the three floors and the walls for the first and second stories of the building had been completed, at a total cost of \$20,287.51.

#### POWER PLANT.

The operation of the power plant during the year has been satisfactory.

The total production of electrical energy was 10,315,790 kilowatt hours, at a cost of 1.46 cents per kilowatt hour.

The average fuel consumption was 0.00733 barrels of oil per kilowatt hour.

In computing the cost of electrical energy, the entire cost of machinery and building in the Gatun power plant is being absorbed. In view of the fact that it is probable that this plant may be used for a year or more to come, and possibly will remain in permanent use in connection with the operation of the canal, it is believed that a credit should be given the lock-construction plant for the cost of the building and a proportional share of the cost of the machinery.

#### GATUN DAM AND SPILLWAY.

[Maj. George M. Hoffman, Corps of Engineers, United States Army, resident engineer, in local charge.]

#### GATUN DAM.

Construction during the year increased the embankment by 1,967,841 cubic yards, making the total net fill in place 21,786,820

cubic yards. Reductions from car and borrowpit measurement were made, amounting to 28.5 per cent, or 784,835 cubic yards, to allow for consolidation and waste; so that the gross amount of material handled amounts to 2,752,676 cubic yards. Of the amount placed this year, 1,714,367 cubic yards was dry fill, 169,004 cubic yards was wet fill, and 84,470 cubic yards was broken stone and heavy riprap, used for paving the lake side slope. To complete the embankment in accordance with the approved plan will require the placing of about 220,000 cubic yards.

Statement of the progress of construction by fiscal years is as follows, showing the dam to be 99 per cent completed:

Year.	Embankment in place.			
	Dry fill.	Wet fill.	Paving material.	Total.
	<i>Cubic yards.</i>	<i>Cubic yards.</i>	<i>Cubic yards.</i>	<i>Cubic yards.</i>
Prior to July 1, 1908.....	462,297	720,047		462,297
1908-9.....	1,781,325	2,933,075		2,501,372
1909-10.....	2,577,234	3,758,870		5,510,309
1910-11.....	2,060,186	2,543,086		5,519,056
1911-12.....	2,982,839			5,525,945
1912-13.....	1,714,367	169,004	84,470	1,967,841
Total.....	11,578,268	10,124,082	84,470	21,786,820

On the basis of net embankment the cost for the fiscal year is 44.62 cents per cubic yard, and for the period since the beginning of construction the cost of same is 39.14 cents per cubic yard.

In calculating the above amounts of material in place, the surface of reference is that shown by original elevations taken on 50-foot squares over the foundation of the dam. Due, however, to the compression of the underlying strata, an excess amount of material has been required to be handled, estimated at 1,600,000 cubic yards. A further great increase in material required to be handled, estimated at 4,000,000 cubic yards, was caused by wasting through the drain pipes a large percentage of the clayey parts of the hydraulic fill considered too soft for the purpose intended. Normal losses due to consolidation, clay naturally carried in suspension, and leakage from pipe joints accounts for a further amount of 1,167,985 cubic yards, making a total of 6,767,985 cubic yards handled but not included in the figures of embankment in place. Place measurement of material handled is shown by fiscal years in the following table:

Period.	Material for embankment.		
	Dry and paving rock.	Wet.	Total.
	<i>Cubic yards.</i>	<i>Cubic yards.</i>	<i>Cubic yards.</i>
Prior to July 1, 1908.....	541,066		541,066
1908-9.....	1,425,060	800,052	2,225,112
1909-10.....	2,061,787	3,730,183	5,791,970
1910-11.....	2,726,094	5,731,896	8,457,990
1911-12.....	3,012,370	5,773,621	8,785,991
1912-13.....	2,259,531	493,145	2,752,676
Total.....	12,025,908	16,528,897	28,554,805

On the basis of material handled the cost for the fiscal year is 31.90 cents per cubic yard, and for the period since the beginning of construction the cost is 29.86 cents per cubic yard.

To check the amount of embankment in place, four complete cross-section surveys of the dam have been made, one in 1910, two in 1911, and one in 1912. No complete survey was made this fiscal year, but partial cross sections were run monthly until February, from which material placed was calculated. For the following months car and borrow pit measurement has been accepted.

The dam has been carried to the full construction grade for the entire length except at two places where a lower level obtains of barely sufficient width to accommodate construction tracks. Construction grade is 105 feet above sea level plus from 4 to 5 feet to allow for consolidation. Some additional material may be required in the future to maintain full grade. To provide for the placing of this, permanent tracks will be left running up the north slope and thence along the top of the dam, both east and west of the spillway.

Levels have been run monthly over the regular construction hubs driven on both slopes about 250 feet apart parallel to the axis and about 100 feet apart transverse thereto. Since the completion of the hydraulic fill the data thus obtained shows an extremely slow rate of consolidation considering that the embankment rises to 110 feet above sea level, that material below sea level for a depth of 200 feet in places is compressible, and that the hydraulic fill near the axis, composed of the finer and more impervious material, was comparatively soft when the red clay extension to the top of the dam was made. Along the completed slopes the percentage of shrinkage is much less than generally obtains in ordinary embankments, probably due to the large percentage of rock in the dry fill and the great tamping effect of the heavy trains used in construction.

On August 29, 1912, while the hydraulic fill was still under way and the slopes were thoroughly saturated by seepage water, a movement of material occurred near the west end of the dam on the north slope. Here rock foundation is found above sea level and a slope of 1:5 had first been adopted, later changed to 1:7.67, but the reinforcement thus provided had just been started on the lower part of the slope below the 60-foot contour. A heavy fill was at once made along the foot of the section affected extending well out on to several small hills; the slope was then completed to the adopted grade and the embankment built up 30 feet higher to the top without any further movement after September 2.

Wash borings, located as shown on the general plan, Gatun Locks and Dam, plate No. 90, have been made to determine the condition of the material as to solidity and water-tightness, the line of demarcation between wet and dry fills, and the present elevation of the original surface. The holes were cased throughout with 2½-inch pipe and drive samples were obtained at intervals of 5 to 10 feet and filed in boxes. That portion of the sample affected by the wash water was rejected, so that the portion preserved shows the actual condition of the material in place. From time to time the casing was filled with water and the rate of lowering recorded, and in addition to this indication of water-tightness the point at which lowering



ceased was in some cases obtained. In driving the  $1\frac{3}{4}$ -inch barrel for a sample the number of blows of a 100-pound weight falling 3 feet required for various penetrations were counted as an indication of the solidity of the material. A few repeat holes were drilled after periods up to a year, showing marked improvement in the solidity of the softer portions of the hydraulic fill. Plate No. 91 is a section of the dam showing the limits of dry and wet fills, and plate No. 92 shows the progress of construction by fiscal years.

Dry fill deposited was received as follows, quantities being in accordance with car measurement:

Locality.	Cubic yards.
Borrow pits.....	
Locks.....	2, 135, 753
Balboa (earth).....	30, 981
	4, 369
Total.....	2, 171, 103

Allowance of 456,736 cubic yards, or 21 per cent of the above, makes the net amount in place 1,714,367 cubic yards.

The cost of net dry fill in place for the fiscal year was 40.84 cents per cubic yard, and for the yardage handled in the same period the cost was 32.25 cents per cubic yard. For all the net dry fill in place the cost was 44.95 cents per cubic yard, and for the total yardage handled to date the cost was 43.55 cents per cubic yard.

Practically all the material for dry fill came from the main borrow pit beyond the west end of the dam and from other borrow pits north of the dam and in the vicinity of the locks. From two to six steam shovels have been engaged in excavating this material, their output being as follows:

	Earth.	Rock.	Total.	Output per shovel—	
				Per day.	Per month.
1912.	<i>Cubic yards.</i>	<i>Cubic yards.</i>	<i>Cubic yards.</i>	<i>Cubic yards.</i>	<i>Cubic yards.</i>
July.....	87, 354	174, 854	262, 208	1, 929	50, 135
August.....	140, 879	132, 843	273, 722	2, 028	54, 744
September.....	163, 125	96, 440	259, 565	1, 938	46, 517
October.....	194, 218	118, 659	312, 877	1, 993	53, 944
November.....	164, 479	58, 815	223, 294	1, 744	41, 785
December.....	104, 270	96, 966	201, 236	1, 649	41, 232
1913.					
January.....	64, 709	78, 920	143, 629	1, 842	47, 873
February.....	45, 155	47, 170	92, 325	1, 232	28, 320
March.....	75, 208	21, 165	96, 373	1, 580	39, 497
April.....	68, 969	36, 941	105, 910	1, 961	52, 955
May.....	56, 074	33, 771	89, 845	1, 728	44, 923
June.....	71, 842	26, 333	98, 175	1, 964	49, 087
Total.....	1, 236, 282	922, 877	2, 159, 159	<sup>1</sup> 1, 829	<sup>1</sup> 46, 354

<sup>1</sup> Average for the year.

Wet fill was pumped into the dam by three pipe-line dredges working in borrow pits upward of  $1\frac{1}{2}$  miles distant, the maximum lift being 100 feet. For the longer pipe lines and higher lifts two relay pumps were inserted in the discharge line to assist the dredges. Material handled by borrow-pit measurement was as follows:

Month.	Dredge No. 83.	Dredge No. 85.	Dredge No. 86.	Total.
1912.	<i>Cubic yards.</i>	<i>Cubic yards.</i>	<i>Cubic yards.</i>	<i>Cubic yards.</i>
July.....	116, 156	66, 959	66, 135	249, 250
August.....	68, 059	55, 869	28, 367	152, 295
September.....			91, 600	91, 600
Total.....	184, 215	122, 828	186, 102	493, 145

Measured in place in the dam, wet fill shows a loss of 324,141 cubic yards, or 65.8 per cent, due to waste through drain pipes, leakage from pipe joints, and consolidation. The net wet fill, therefore, amounted to 169,004 cubic yards.

The cost of the above wet fill, on the basis of net embankment in place, was 32.19 cents per cubic yard; and on the basis of yardage handled the cost was 11.03 cents per cubic yard. For the total completed wet fill the corresponding costs were 31.64 cents per cubic yard and 19.38 cents per cubic yard.

Early in the year filling with the dredges was completed. Three of them were transferred to other work, and the fourth was laid up after thorough repair to make it ready for excavating the deposits of gravel and sand in the prism near Gamboa. Dredge No. 85 was dismantled, the hull pulled out on the extemporized ways where it was cut into sections by the oxy-acetylene process; all parts and machinery were shipped by rail to Balboa to be reconstructed for work in that vicinity.

In connection with furnishing wet fill for the dam, dredge No. 86 also loaded barges with washed sand for concrete from May to August, 1912, furnishing 32,968 cubic yards after July 1. In March, 1913, there was still a deficiency of sand and the dredge was again placed in this service, excavating 10,883 cubic yards from the 13th to the 25th. The cost of this sand in storage pile was 51.88 cents per cubic yard. As excavated from the borrow pit, the material contained at times as much as 50 per cent of silt, clay lumps, rotten wood, and boulders. A simple but extremely effective method was used to eliminate such foreign matter. A small pile dock was built along which a barge was placed and to which a branch of the dredge pipe was brought discharging into a chute 4 feet wide extending across the breadth of the barge. The chute being hinged at the dock end supported by a small derrick was adjustable for slope, its bottom was pierced by three openings, 1 by 4 feet, in which gratings of bars with three-fourth inch intervals were set. All of the bulky debris was thus passed to the end of the chute where it dropped into deep water, while the sand, silt, and nearly all the water passed through the grated openings into the sand compartment of the barge; this promptly filled with water, and an overflow over the coaming being established carried off practically all the silt.

Paving of the lake side slope of the dam for a width of 139.2 feet, extending between the 74-foot and the 92-foot contours, was begun in February, 1913. Broken stone from the Ancon crusher was first spread to a depth of about 4 inches, over which was roughly placed heavy riprap armor, obtained at first from a quarry opened at Quebrancha Hill, and later from excavations at Sosa Hill and the Balboa Dry Dock. The broken stone layer was completed in April, 15,740 cubic yards of crushed stone being placed, covering the total area of 115,740 square yards. Riprap stone in place amounts to 68,730 cubic yards, covering an area of 102,030 square yards, and making this item 88.2 per cent completed.

In finishing up the completed slopes of the dam, the inequalities left by the dumps are being graded off to a sufficient degree of smoothness to permit the operation of a horse or power mower for cutting weeds. The area surfaced in this manner has amounted to 225,460 square yards, at a unit cost of 2.36 cents. Experience has shown that if the weeds are cut off about twice a year, the slopes of the dam will naturally grass over, eventually forming a sod that will shed the rainfall from the extremely porous dry fill beneath, and will revet the slopes against the gullying effects of rain wash.

*Comparative statement of costs—Gatun Dam.*

Gatun dam construction.	1912					
	July.	August.	September.	October.	November.	December.
Dry fill (cubic yards).....	207,405	201,029	184,300	258,999	184,485	142,245
Excavation.....	\$0.0678	\$0.0625	\$0.0787	\$0.1171	\$0.0763	\$0.0771
Tracks.....	.0886	.1197	.1122	.0698	.1045	.0855
Trestles.....	.0009	.0010	.0030	.0003	.0001	.....
Transportation.....	.0752	.0917	.0840	.0758	.0930	.0776
Filling.....	.0357	.0484	.1256	.0714	.1222	.1067
Maintenance of equipment.....	.0376	.0306	.0622	.0524	.0364	.0577
Division expense.....	.0212	.0247	.0292	.0318	.0326	.0268
Total division cost.....	.3270	.3766	.4949	.4186	.4651	.4314
Administration and general expense.....	.0239	.0298	.0469	.0305	.0456	.0419
Total cost.....	.3509	.4064	.5418	.4491	.5107	.4733
Hydraulic fill (cubic yards)...	108,463	43,589	62,666	.....	.....	.....
Clearing for dredges.....	.0142	.0336	.0050	.....	.....	.....
Operation of dredges.....	.1577	.2364	.0585	.....	.....	.....
Relay pumps.....	.0214	.0384	.0078	.....	.....	.....
Pile lines.....	.0149	.0435	.0206	.....	.....	.....
Power.....	.0957	.1911	.0238	.....	.....	.....
Flumes.....	.0028	.0038	.0013	.....	.....	.....
Small boats.....	.0034	.0113	.0245	.....	.....	.....
Maintenance of equipment.....	.0476	.1535	.0534	.....	.....	.....
Division expense.....	.0129	.0303	.0092	.....	.....	.....
Total division cost.....	.3706	.7419	.2041	.....	.....	.....
Administration and general expense.....	.0215	.0502	.0200	.....	.....	.....
Total cost.....	.3921	.7921	.2241	.....	.....	.....

*Comparative statement of costs—Gatun Dam—Continued.*

Gatun dam construction.	1913					
	January.	February.	March.	April.	May.	June.
Dry fill (cubic yards) . . . . .	149,609	\$8,792	96,101	106,862	93,449	99,457
Excavation . . . . .	\$0.0329	\$0.1049	\$0.1097	\$0.0786	\$0.0807	\$0.0300
Tracks . . . . .	.0210	.0605	.0791	.0374	.0668	.0648
Trestles . . . . .	.0001	.0001		.0008		
Transportation . . . . .	.1874	.0133	.0485	.0474	.0587	.0504
Filling . . . . .	.0568	.0920	.0927	.0650	.0802	.0691
Maintenance of equipment . . . . .	.0297	.0807	.0487	.0506	.0597	.0096
Division expense . . . . .	.0139	.0151	.0121	.0086	.0169	.0124
Total division cost . . . . .	.0330	.3666	.3908	.2884	.3630	.2363
Administration and general expense . . . . .	.0203	.0475	.0259	.0128	.0209	.0148
Total cost . . . . .	.0127	.4141	.4167	.3012	.3839	.2511

## GATUN SPILLWAY.

Construction of the spillway dam proceeded in accordance with the approved schedule which provided for carrying the flanks toward completion as rapidly as possible, but holding the central section at elevation plus 50 so as to give an escape weir about 370 feet wide for the heavy floods of November and December, thus insuring against an excessive rise of the lake which might overtop the Gamboa Dike and flood the Culebra Cut. The closure of this gap was undertaken as soon as the level of the lake had dropped below the 50-foot level, and the work was advanced as rapidly as possible by increasing the force and continuing operations on Sundays, holidays, and at night. As sections of the ogee were completed the trestle erected on the flanks at elevation 95 was extended, and from it the crest piers were constructed to the full height, elevation 115. The 14 crest gates, weighing 42 tons each, were placed in position between the piers by two wrecking cranes operating from this high trestle. At the erecting yard east of the locks the wrecking cranes loaded a gate in a vertical position on a flat car; the car was slowly hauled to the spillway and spotted between the cranes opposite the gate's position on the dam; attachment was then made, and the gate lifted, swung to an exact position above the fixed iron guides, and lowered into place. From two to six gates were placed in a day, and the work was completed on April 15. After the completion of the west abutment the high trestle opposite each gate in succession was dismantled, and the upstream side of the respective piers encroached on by the trestle could then be built. It will be impracticable to do this at the three central piers and eastward until the control sluices under these piers are no longer needed, when the sluices will be filled with concrete, the piers and east abutment finished, and the dismantling of the trestle completed.

Originally there was a fourth sluiceway left under Pier No. 9, in which was installed for experimental purposes a cylindrical valve similar to those in the center lock wall. This sluiceway was closed off early in February, the valve removed, and the opening filled

with concrete. Closure on the lake side was effected by a timber gate lowered in stop grooves and made almost water-tight with a stiff mixture of cement and sawdust plastered around the gate by a diver. A heavy block of concrete was first built next the timber gate, the small amount of leakage being carried through same in a pipe; after this concrete had thoroughly set the pipe was closed with a valve and the remainder of the opening filled with concrete. On completion of the closure no seepage could be detected.

At the beginning of the year Gatun Lake had filled to elevation 30.2. In order to complete the guard gates and caisson sills at the locks, the sluice gates were opened and the lake held at about elevation 32 until the last week in August. After elevation 48 was reached, in September, the gates were again opened, so as not to interfere with concrete construction on the spillway dam; but in November and the first half of December the water was allowed to rise to a maximum elevation of 56.3, in spite of the heavy outflow over the weir and through the open sluices. After the subsidence of the flood the water was allowed to drop to elevation 48 to permit resumption of work on the spillway dam, and was held at about this elevation until June 27, when the valves were closed to allow the lake to fill to its final level.

Advantage was taken of the flow over the spillway in November and December to dispose of a large number of islands, snags, and old timber floating on the lake surface. Excellent results were accomplished by the tug *Balboa* and a gasoline launch, which pushed about 2 square miles of the floating islands over the crest and thoroughly cleared the anchorage basin and the north end of the channel of all obstructions. The *Balboa*, with the assistance of a floating pile driver, also cleared  $1\frac{1}{2}$  miles of the 1,000-foot channel, about 6 miles south of Gatun, of heavy masses of floating island, breaking same into pieces and stranding them among the standing timber off the channel. This obstruction completely blocked the channel, was in places 14 feet thick, and apparently floated directly upward from the floor of the old swamp below. So thoroughly matted was it with snags, sticks, and roots of living vegetation that it was immovable until broken up into small sections by the powerful tackle of the floating pile driver.

Excavation for the spillway dam is completed, and concrete work 97.9 per cent completed. Progress by fiscal years has been as follows:

Year.	Excavation.	Concrete.
	<i>Cu. yds.</i>	<i>Cu. yds.</i>
Prior to July 1, 1907.....	3, 832	
1907-08.....	938, 901	
1908-09.....	359, 821	30, 464
1909-10.....	127, 610	53, 632
1910-11.....	157, 628	59, 651
1911-12.....	7, 123	58, 666
1912-13.....	175	21, 719
Total.....	1, 595, 090	224, 132

## PERMANENT POWER PLANT.

Preparation of the foundation was completed and the masonry substructure almost completed. Erection of the superstructure steel was commenced on May 16. At the end of the year 65.3 per cent of the steel had been erected and 90 per cent of the field rivets driven. The penstocks have been cased with concrete except for the curved portions near the head gates. The forebay walls, with trash-rack and stop-plank grooves, are about 95 per cent completed.

*Comparative statement of costs—Gatun spillway.*

## MASS CONCRETE.

	1912					
	July.	August.	September.	October.	November.	December.
Concrete (cubic yards).....	1,357	1,111	976	1,303	855	3,017
Cement.....	\$1.5298	\$1.5972	\$1.5523	\$1.4435	\$1.6194	\$1.4637
Stone.....	1.9703	1.9998	1.9987	1.8037	2.0035	1.8325
Sand.....	.5925	.5382	.5914	.5076	.5965	.5500
Wood forms.....	1.9766	2.0555	2.6318	1.2802	1.4602	1.8278
Mixing.....	.7380	1.0765	1.1368	.7469	.9704	.4663
Transportation from mixer.....	.7919	.6191	1.0772	.3467	.7980	.3840
Placing.....	.6559	.7128	.6953	.5131	1.2331	.4696
Reinforcements.....	.1086		.0849			
Pumps.....	.0016	.0046	.0222			
Cofferdam.....					.3639	
Maintenance of equipment.....	1.0706	.6983	.6822	.2388	.2724	.2184
Plant, arbitrary.....	.5340	.5340	.5340	.5340	.5340	.5340
Division expense.....	.4124	.3686	.4577	.3244	.2002	.1812
Total division cost.....	10.3852	10.2046	11.4645	7.8289	9.3838	7.9275
Administration and general expense.....	1.0300	1.3218	1.2055	.8697	.8983	.6566
Total cost.....	11.4152	11.5264	12.6700	8.6986	10.2821	8.5841

	1913					
	January.	February.	March.	April.	May.	June.
Concrete (cubic yards).....	3,817	3,028	2,659	1,358	717	455
Cement.....	\$1.3371	\$1.2863	\$1.4597	\$1.5031	\$1.6667	\$1.8352
Stone.....	1.0882	.9562	.9955	1.0484	1.1116	.7151
Sand.....	.4741	.5939	.3681	.2984	.3490	.4027
Wood forms.....	1.2332	1.5645	1.4952	2.5117	2.4600	4.0819
Mixing.....	.2400	.3354	.3283	.4387	.8382	.8872
Transportation from mixer.....	.3226	.3914	.1949	.3890	.6329	.5070
Placing.....	.4100	.7037	.7812	.5312	1.8825	.8641
Reinforcements.....	.0469	.1182	.0017	.2292	.0058	
Pumps.....			.0101			
Cofferdam.....		.0157		.0994	.5002	1.7531
Maintenance of equipment.....	.1798	.3481	.2890	.3616	.2066	.0263
Plant, arbitrary.....	.2540	.2540	.2540	.2540	.2540	.2540
Division expense.....	.1511	.1417	.1234	.3194	.4739	.8236
Total division cost.....	5.7370	6.7091	6.3011	7.9841	10.3814	12.1802
Administration and general expense.....	.4505	.5179	.5875	2.0498	1.6662	2.3853
Total cost.....	6.1875	7.2270	6.8886	10.0339	12.0476	14.5655

## Comparative statement of costs—Gatun spillway—Continued.

## REINFORCED CONCRETE.

	1912					
	July.	August.	September.	October.	November.	December.
Concrete placed (cubic yards).		112	112	314		49
Cement.....		\$2.2500	\$1.5536	\$1.4414		\$1.4676
Stone.....		2.0003	2.0089	1.8020		1.8280
Sand.....		.5353	.5937	.5996		.5484
Mixing.....		1.0570	.6969	.7538		.5933
Forms.....		5.4806	1.4729	.0475		37.1785
Placing.....		.7130	.6712	.0847		.9829
Reinforcements.....		16.6386	2.5053	.2012		32.0088
Transportation from mixer.....		.6193	1.0717	.3491		.3838
Maintenance of equipment.....		.0985	.6819	.2414		.2302
Plant, arbitrary.....		.5340	.5340	.5340		.5340
Division expense.....		.5650	.4710	.1684		2.4493
Total division cost.....		31.0946	12.2611	6.2231		78.2049
Administration and general expense.....		4.2853	1.3574	.3168		16.0018
Total cost.....		35.3799	13.6185	6.5399		94.2067

	1913					
	January.	February.	March.	April.	May.	June.
Concrete placed (cubic yards).	369					110
Cement.....	\$1.3381					\$1.8497
Stone.....	1.0906					.7522
Sand.....	.4716					.2925
Mixing.....	.3826					.8965
Forms.....	3.1144					2.2141
Placing.....	.6605					.8425
Transportation from mixer.....	.3224					.5124
Maintenance of equipment.....	.2364					.0266
Plant, arbitrary.....	.2540					.2568
Division expense.....	.2990					.4963
Total division cost.....	8.1696					8.1396
Administration and general expense.....	.8804					1.3724
Total cost.....	9.0500					9.5120

Excavation amounted to 14,948 cubic yards, costing 43.82 cents per cubic yard. Preparation of foundations amounted to 11,684 cubic yards, costing \$1.9794 per cubic yard. Total excavation to date, including preparation of foundations, amounts to 98,751 cubic yards.

A total of 5,068 cubic yards of concrete was placed at an average cost of \$9.0463 per cubic yard.

Plans for the underground duct line to the locks and the steam-power plant were received and work was begun the last week in June, 8 yards of concrete being laid as foundation for ducts.

## MUNICIPAL ENGINEERING.

[Mr. George M. Wells, office engineer, in local charge.]

The new purification plant at Agua Clara, constructed during the previous fiscal year, was successfully operated throughout the year. This plant consists principally of raw-water mixing chambers; sedi-

mentation basin; four filter units, each having a capacity at 125,000,000 gallons per acre per day rate, of 750,000 gallons per day of 24 hours; a clear-water basin having a capacity of 225,000 gallons; a wash-water tank having a capacity of approximately 10,000 gallons; an electric-pump station containing two multistage electric-driven pumps, each having a capacity of approximately 1,400 gallons per minute; and two motor-driven air compressors for furnishing air for assisting in cleaning the filters.

The water from the Agua Clara Reservoir is fed by gravity to the mixing chambers, where there is introduced a dose of aluminum sulphate varying from 0.5 to 1.5 grains of chemical per gallon of water. After passing through these mixing chambers, the treated water passes on to the sedimentation basin, where sedimentation takes place, varying from three to eight hours. The water then passes onto the filter beds, consisting of a 16-inch layer of gravel on the bottom supporting a 30-inch depth of specially prepared sand having a mean effective size of approximately 0.4 mm. The water then passes from these filters to the clear-water basin, from which point the pumps force it into the mains leading to the 450,000-gallon high-pressure tower tank located at Gatun. The results obtained from these filters for the period from July, 1912, are given in the table submitted herewith.

The last three months of the fiscal year are not included in the statement because of the fact that experiments had indicated that even more successful results could be obtained by installing an independent wash-water supply fed by gravity from a tank located immediately above the filters on the adjacent hill. During the time that this change was being made the sand and gravel from each filter was removed, washed, and replaced, and the gravel bed increased in depth to take care of the increased wash rate that would result from the new wash supply.

*Agua Clara filters and reservoir.*

Month.	Rainfall.	Elevation reservoir.	Alkalinity (per million).		Coagulant aluminum sulphate.	Turbidity (per million).	
			Raw.	Filtered.		Raw.	Filtered.
1912.	<i>Inches.</i>	<i>Feet.</i>			<i>Pounds.</i>		
July.....	13.50	59.2	35.0	26.0	4,500	5.0	0
August.....	12.60	61.8	29.0	17.0	1,800	2.5	0
September.....	8.62	63.3	28.0	17.0	4,700	2.5	0
October.....	17.64	67.7	28.0	18.0	5,210	10.0	0
November.....	17.65	68.0	33.0	19.1	5,280	10.0	0
December.....	8.10	68.1	32.9	18.8	5,992	10.0	0
1913.							
January.....	5.53	66.5	31.0	14.0	5,000	10.0	0
February.....	3.70	64.4	29.0	14.0	6,045	20.0	0
March.....	.20	61.1	29.2	14.1	6,920	20.0	0
April.....	3.75	58.3			7,750		
May.....	14.54	58.8	25.0	8.0	8,250	20.0	0
June.....	10.87	60.2	26.0	10.0	6,375	20.0	0
	116.70				70,822		



*Agua Clara filters and reservoir—Continued.*

Month.	Color (per million).		Odor (per million).		Bacteria (per c. c.).		Monthly consumption.
	Raw.	Filtered.	Raw.	Filtered.	Raw.	Filtered.	
1912.							<i>Gallons.</i>
July.....	25	0	0	0	1,005	96	22,948,000
August.....	15	0	0	0	961	82	23,721,000
September.....	15	0	0	0	1,006	42	19,302,000
October.....	20	0	0	0	853	23	20,188,000
November.....	25	0	0	0	721	53	20,595,000
December.....	25	0	0	0	839	69	23,038,000
1913.							
January.....	20	0	0	0	825	71	25,996,500
February.....	35	0	0	0	632	105	24,119,000
March.....	35	0	S. veg.	0	509	81	28,314,000
April.....					1,261	423	24,421,000
May.....	50	0	Veg.	0	1,026	196	27,101,000
June.....	40	0	Veg.	0	829	183	26,361,500
							286,104,000

During the period March 1 to May 12, 1913, 3,225,000 gallons of water were transported from Mindi to Toro Point.

The average daily consumption exclusively for use at Gatun amounted to approximately 2,335,000 gallons per day. During the time it was necessary to transport water to Toro Point this amount was increased to approximately 2,380,000 gallons per day.

The usual work of shifting, relaying, and maintaining the miscellaneous pipe lines of the water system was carried on throughout the year.

## AGUA CLARA RESERVOIR.

The regular maintenance of the banks of the reservoir was continued throughout the year.

The water in the reservoir began to fall on January 10, 1913, and continued to fall until May 12, 1913, when it reached its lowest elevation of 57.2.

## ROADS, SEWERS, AND DRAINS.

The usual maintenance work on roads, sewers, and drains was carried on throughout the year, and the entire sewer system was flushed on an average of twice each month.

## CRISTOBAL AND COLON.

## WATERWORKS.

The operation of the pump station and pressure filtration plant at Mount Hope was continued during the year more or less continuously. Considerable difficulty was experienced from time to time in the operation of the filters, due to their being excessively overloaded and to the fact that the sedimentation basin was of such size that the necessary length of time for sedimentation was not possible. This resulted in putting heavy pressures on the filters, causing rapid clog-

ging and the breaking down of the strainer systems to such an extent that comparatively large quantities of sand escaped into the mains leading to Colon. The filters were thrown out of service three different times, the sand and gravel removed and washed, and a total of 1,000 strainers replaced.

In order to obviate the possibility of a shortage of water during the dry season, such as occurred during the last fiscal year, the temporary pump station at the Mindi diversion was thrown into service on December 28, 1912. From that date until April 27, 1913, this station furnished approximately 1,000,000 gallons of water per day.

The following table gives the results of the operation of the filters and the action of the Brazos Brook reservoir during the year.

*Mount Hope filters and Brazos Brook reservoir.*

Month.	Rainfall.	Elevation reservoir.	Alkalinity (per million).		Coagulant aluminum sulphate.	Turbidity (per million).	
			Raw.	Filtered.		Raw.*	Filtered.
1912.	<i>Inches.</i>	<i>Feet.</i>			<i>Pounds.</i>		
July.....	16.87	39.1	19.5	9.2	15,945	0	0
August.....	14.42	41.6	25.0	15.0	16,295	5	0
September.....	9.11	42.3	25.5	15.1	17,160	10	0
October.....	17.86	44.9	25.0	15.0	19,231	15	0
November.....	19.86	48.8	25.2	18.2	18,000	15	0
December.....	9.03	47.8	25.3	17.9	19,210	18	0
1913.							
January.....	5.72	45.7	25.0	10.0	25,178	20	0
February.....	4.29	43.2	25.0	10.0	29,840	25	0
March.....	.71	39.9	25.1	10.2	30,121	35	0
April.....	5.08	37.1			30,240		
May.....	18.57	39.5	24.2			20	
June.....	9.73	40.5	22.0	8.0	27,000	25	0
	131.25				248,220		

Month.	Color (per million).		Odor (per million).		Bacteria (per c. c.).		Monthly consumption.
	Raw.	Filtered.	Raw.	Filtered.	Raw.	Filtered.	
1912.							<i>Gallons.</i>
July.....	35	0	0	0	983	299	81,995,000
August.....	25	0	0	0	925	165	87,099,000
September.....	30	0	0	0	1,028	215	80,266,000
October.....	40	0	0	0	935	187	85,196,000
November.....	35	0	0	0	929	121	84,855,000
December.....	40	0	S. earth.	0	1,021	198	86,490,000
1913.							
January.....	40	5	S. swpy.	S. swpy.	1,126	201	85,718,000
February.....	40	5	Veg.	S. veg.	1,031	396	77,616,000
March.....	40	8	Veg.	S. veg.	699	329	82,438,000
April.....					1,690		76,415,000
May.....	60		Veg.		998		68,944,000
June.....	50	0	Veg.	0	1,126	321	73,174,000
							970,206,000

As stated in the last annual report, general plans and estimates of cost were submitted for the construction of a modern filtration plant and pump station to take the place of the present plant. This

project was approved on July 12, 1912, at an estimated cost of \$193,768. The project, in general, involves the following:

A tunnel through the divide separating the Gatun Lake from the Brazos Brook reservoir, within which was laid a 20-inch main having its inlet at an elevation of approximately 5 feet below the extreme low-water level of Gatun Lake. This pipe line, after passing through the tunnel, a distance of 600 feet, extends down onto the surface of the Brazos Brook reservoir, ending in a control house through the mechanism of which the level of water on the Brazos Brook reservoir is maintained at a minimum low level of 1 foot below the spillway crest. By this arrangement, when the run-off from the Brazos Brook watershed is not sufficient to meet the demands of consumption the additional amount required is automatically allowed to run into the reservoir from the Gatun Lake. An additional 20-inch main was laid from the Brazos Brook reservoir to Mount Hope, the site of the new purification plant and pump station. The water from the reservoir will flow by gravity through these two 20-inch mains to an aeration basin, where, by means of specially designed sprinkling nozzles, it will be thrown up into spray, thus aerating it as it passes to the head house and mixing chambers. At this latter point the water will receive a dose of aluminum sulphate, and after thorough mixing by means of overflow and submerged weirs, combined with compressed air agitation, it will flow into the sedimentation basin, having a capacity of approximately 2,500,000 gallons. This capacity is such as will give a minimum of eight hours sedimentation for the maximum capacity of the plant. After sedimentation the water passes into the filter building and into six filter units, each having a nominal rated capacity of 1,250,000 gallons per day of 24 hours. The water passes from these filters through a specially designed automatic rate controller and discharges through the floor of the pipe gallery into a clear-water basin forming the basement of the filter building. This basin has a capacity of approximately 650,000 gallons. By means of an underground conduit the water passes from this basin into a pump sump beneath the floor of the pump station, and from this point it is pumped by means of electrically driven pumps into the main leading to Cristobal and Colon.

The nominal capacity of this plant, with five filters in operation, is approximately 6,000,000 gallons per day, but by increasing the rate per acre per day the plant can be made to furnish 7,500,000 gallons of filtered water per day of 24 hours.

Work was commenced on this plant in October, 1912, and by the end of the fiscal year all work between Gatun Lake and Brazos Brook reservoir had been practically completed; the additional 20-inch main from Brazos Brook to Mount Hope was 90 per cent completed; the pump station was completed ready for the installation of the machinery; the filter building was completed up to and including the operating floor; the sedimentation basin was 75 per cent completed; and the foundations and floors of the mixing chambers and aeration basin have been laid.

The existence of a concrete drain beneath the Panama Railroad leading to the old French canal fixed the lowest drainage point for this plant at approximately 10 feet above sea level. This necessitated carrying the floor of the clear-water basin to approximately

5 feet below sea level. The excavation for this building developed the fact that the site chosen for the plant had originally been a swamp upon the surface of which had been dumped at some time from 3 to 6 feet of red clay. The excavation of this material to 5 feet below sea level during the three rainiest months of the year resulted in slides and other difficulties that seriously delayed the progress of construction work. In addition to this, small running springs were uncovered beneath the site of the sedimentation basin which resulted in the necessity for driving concrete piles beneath a portion of the basin in order to insure no future settlement taking place. The equipment for this plant was placed under contract in the United States on November 20, 1912, and this contract called for complete delivery on or before April 19, 1913. Very little of this material had been delivered up to that date, and at the end of the fiscal year a large amount still remained undelivered. The delay in the receipt of this material also seriously handicapped the progress of the work.

It is expected that this plant will be ready for operation in November, 1913.

#### BRAZOS BROOK RESERVOIR.

In addition to the work outlined above, the usual maintenance work was carried on during the year.

#### COLON IMPROVEMENTS.

Up to May 20, 1913, all work in connection with the Colon improvements had been completed and turned over for maintenance to the department of public works, with the exception of a certain portion lying between Ninth and Second Streets, extending from G Street west on the cross streets a varying distance of from 30 to 300 feet. Work in this area was suspended for six months to allow the fill to stop settling. Work was again commenced in February, 1913, and at the same time authority was given to fill and macadamize G Street. At the end of the fiscal year there remained a comparatively small amount of gutter and macadam work to be completed on the cross streets between Ninth and Second; the gutter on both sides of G Street had been completed, and the macadam work on G Street had been carried from Ninth to Seventh. It is expected to have this entire project completed within the next 45 days.

Authority was granted on May 5, 1913, to extend the west side of E Street to its intersection with the Mount Hope Road. This work was 85 per cent completed at the end of the fiscal year.

During the year the usual maintenance work was performed in connection with the water lines and sewer systems.

#### TRANSPORTATION.

The following is a list of the equipment in the transportation service of the Atlantic division on June 30, 1913:

Standard gauge equipment:

American locomotives	16
French, Rogers type, and old Panama Railroad locomotives	11
Wrecking crane (No. 64)	1
Track shifter	1

## Standard gauge equipment—Continued.

Steel flat cars.....	13
Lidgerwood flat cars, without sides.....	17
Lidgerwood flat cars, with sides.....	62
Oliver dump cars (19-yard).....	178
Western dump cars (12-yard).....	6
Western dump cars (18-yard).....	7
Roger ballast cars.....	1
Lidgerwood plow unloaders.....	3
Lidgerwood unloaders.....	2
Pile drivers.....	3
Spreaders.....	3
Labor cars.....	14
Box cars, used as cabooses.....	3
Camp cars.....	2
Motor car.....	1
Narrow-gauge equipment:	
Locomotives (3-foot gauge).....	8
Steel dump cars.....	8
Wooden dump cars.....	27
Steel flat cars.....	16
Steel flat cars in concrete service.....	22

Respectfully submitted.

WM. L. STIBERT,

*Lieutenant Colonel, Corps of Engineers, U. S. Army;**Member of the Isthmian Canal Commission;**Division Engineer, Atlantic Division.*

Col. GEORGE W. GOETHALS, United States Army.

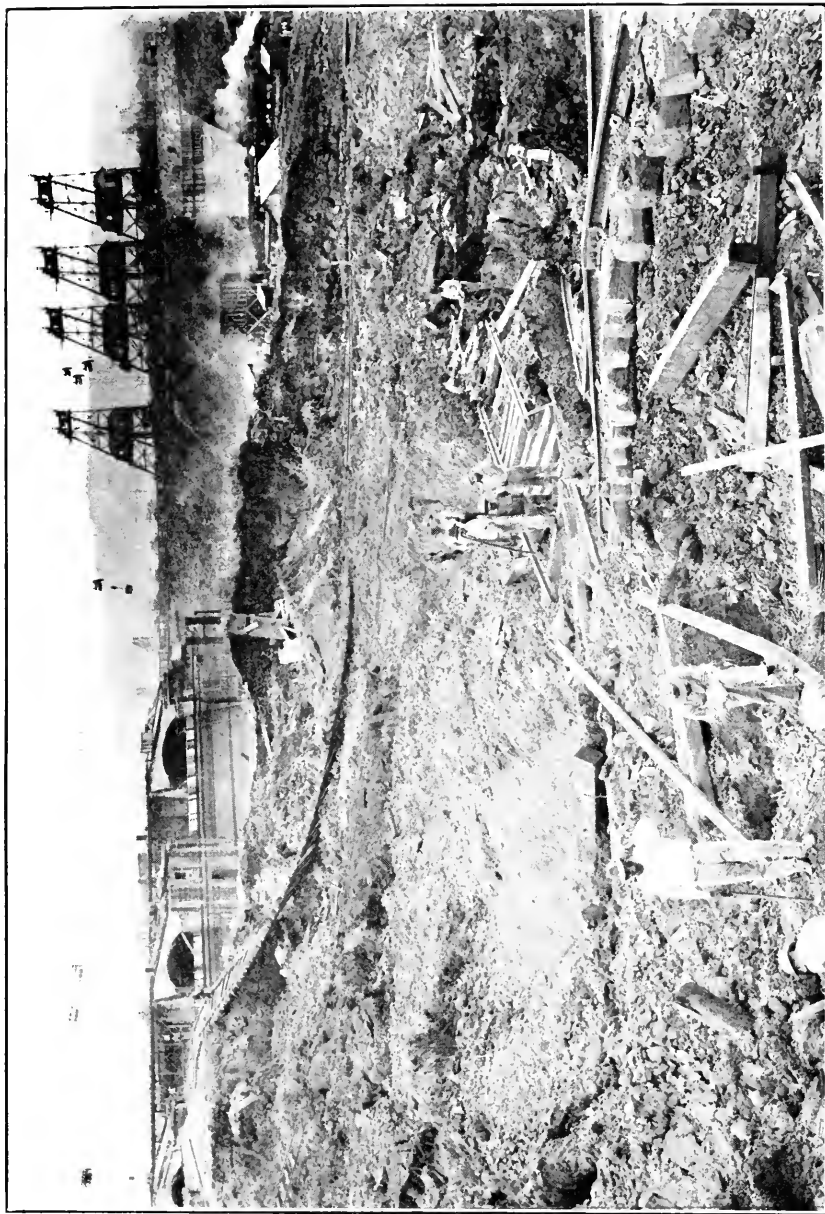
*Chairman and Chief Engineer, Culebra, Canal Zone.*

## EXHIBIT 1.

*Progress report for fiscal year 1912-13.*

	Locks.	Dam and spillway.	Dredg- ing.	Porto Bello.	Municipal en- gineering.	Break- water.	Total.
Steam-shovel excavation:							
In prism.....cubic yards.	322,167						322,167
Crane and cableways, prism, cubic yards.....	18,549						18,549
Auxiliary.....cubic yards..	125,277	396,457		404,251			925,985
Crane, hand, and sluicing, auxiliary.....cubic yards..	2,569				6,931		9,500
Dredge excavation, in prism, cubic yards.....	160,346						160,346
Total excavation, cubic yards.....	628,908	396,457		404,251	6,931		1,436,547
Breakwater rock placed, cubic yards.....						183,762	183,762
Explosives used, tons, 2,240 pounds.....	39.90	177.20		104.93		.63	322.66
Rock drilled.....feet..	64,151	69,633		111,510	60		245,354
New track laid.....do..	25,164	66,938		63,824		2,135	158,064
Material placed in dams, yards..		2,108,201					2,108,201
Cement used.....barrels..	220,009	30,234			3,753		253,996
Concrete placed.....yards..	166,284	26,665			4,264		187,213
New roads built.....feet..					5,753		5,753
Roads resurfaced.....linear feet					19,328		19,328
Water mains laid.....feet..					19,958	8,665	28,623
Sewers laid.....do..					4,484		4,484
Open drains and ditches dug and cleaned, feet.....					348,072		348,072

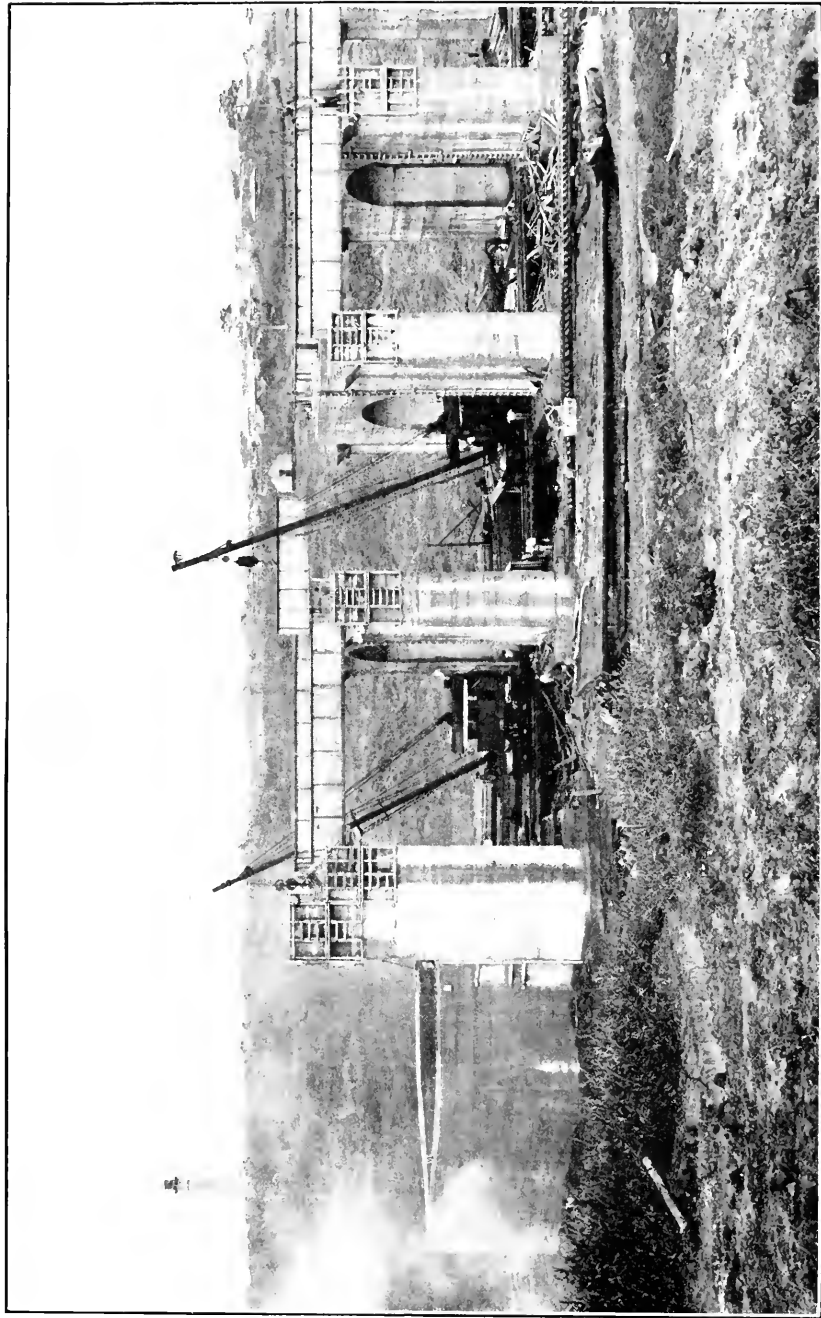




GATUN LOWER LOCKS, NORTH END. THE SLIDE IN THE EAST BANK, LOOKING WEST FROM TOP OF SLIDE.  
JANUARY 25, 1913.







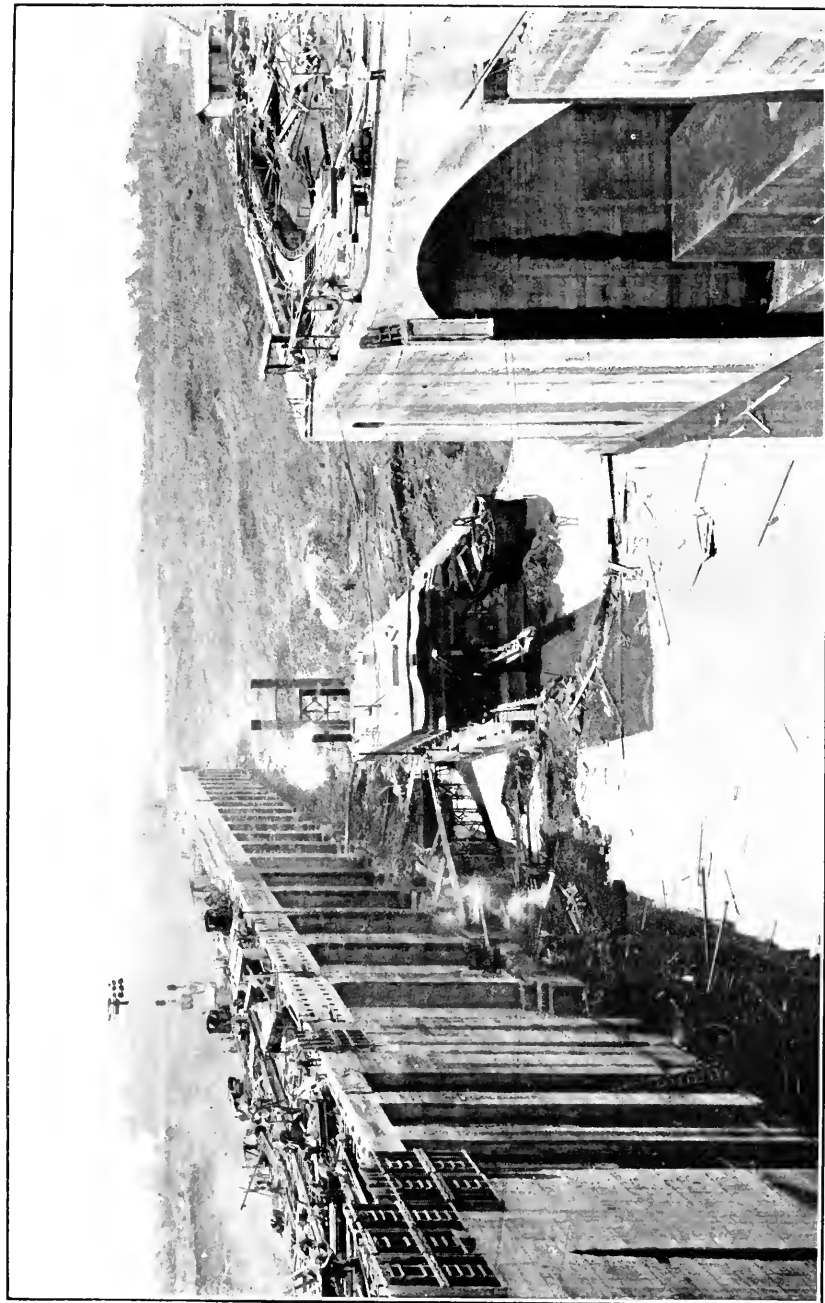
GATUN LOWER LOCKS. PLACING IRON GIRDERS ON NORTH APPROACH WALL, MAY 23, 1913.





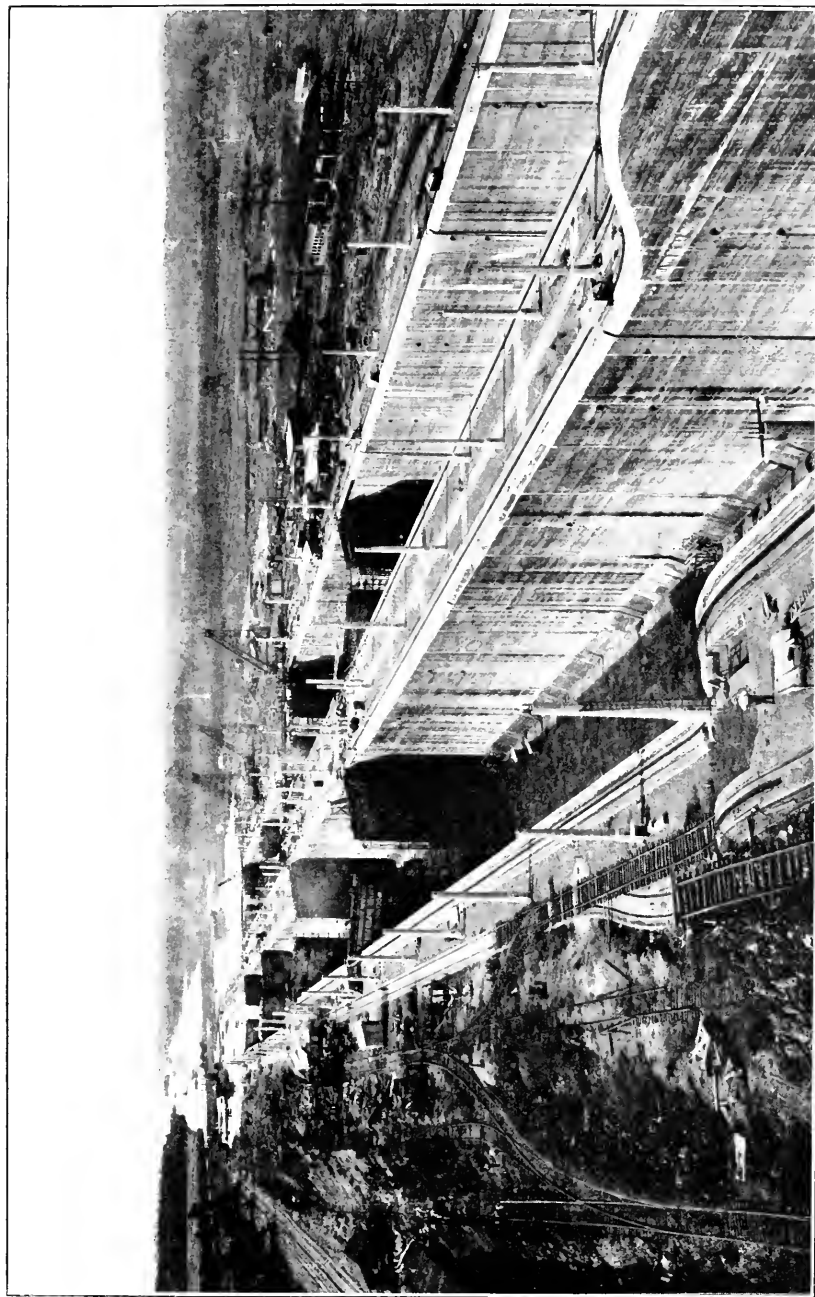
GATUN LOWER LOCKS. INTERIOR VIEW OF NORTH APPROACH WALL.  
MAY 26, 1913.





GATUN LOCKS. NORTH APPROACH WALL, LOOKING NORTHWEST. DREDGE GROUNDED 55 FEET BELOW SEA LEVEL.  
JUNE 14, 1913.

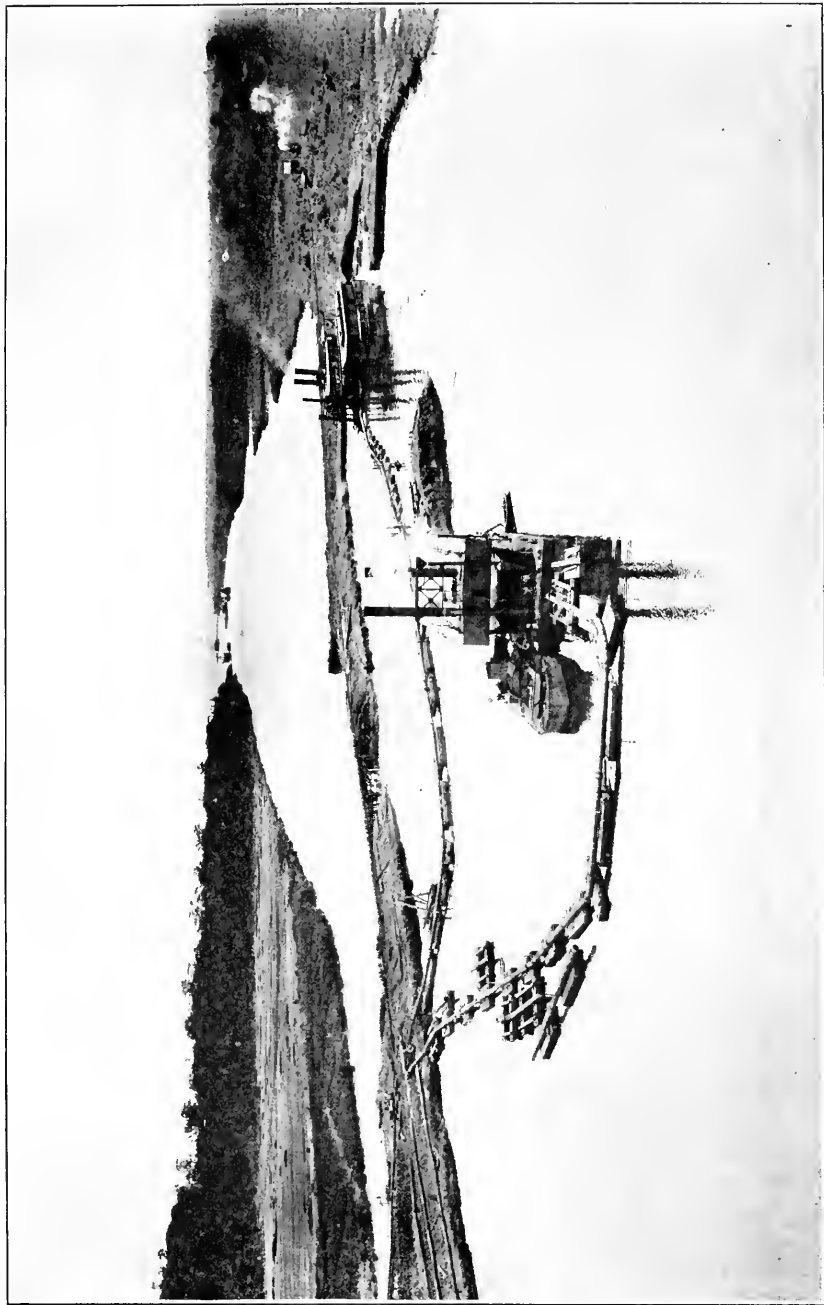




GATUN LOCKS, LOOKING NORTH, SHOWING INTERMEDIATE AND LOWER LOCKS. JUNE 25, 1913.

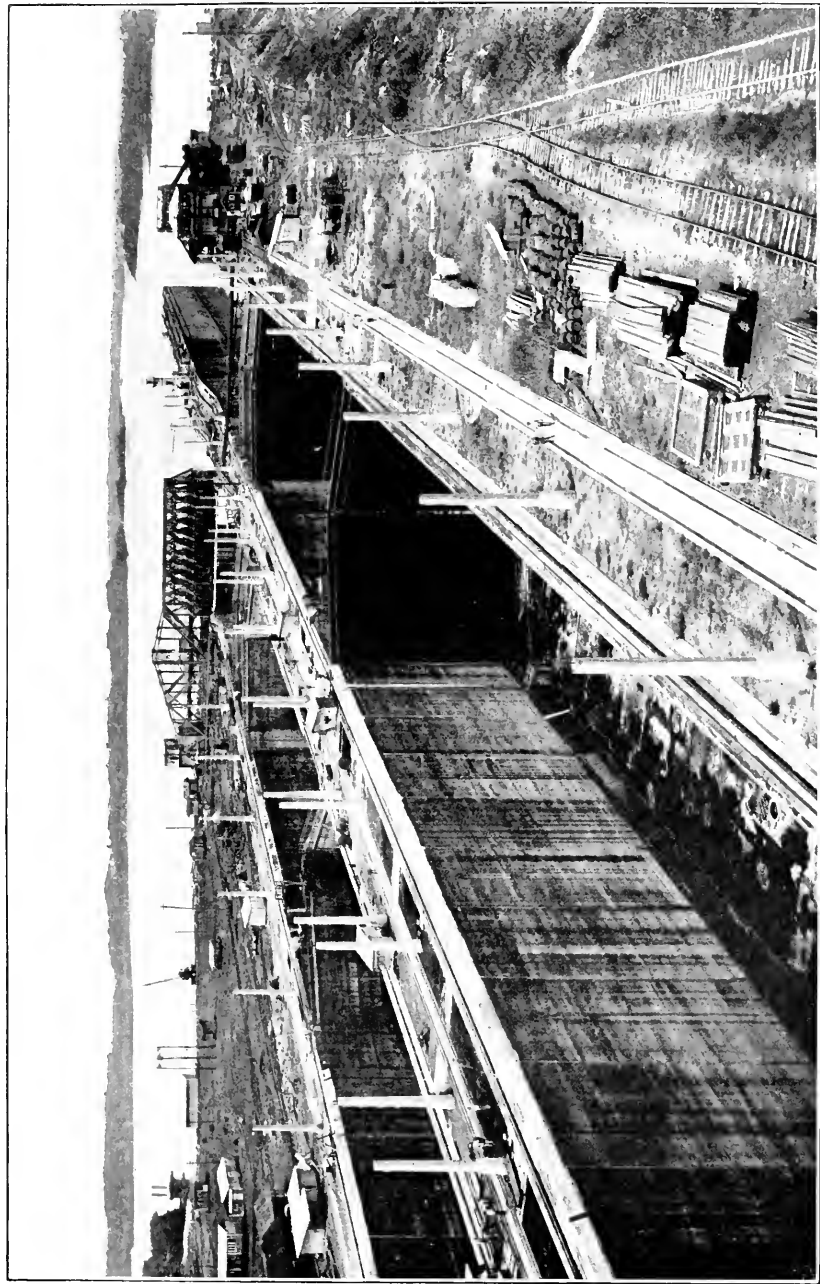






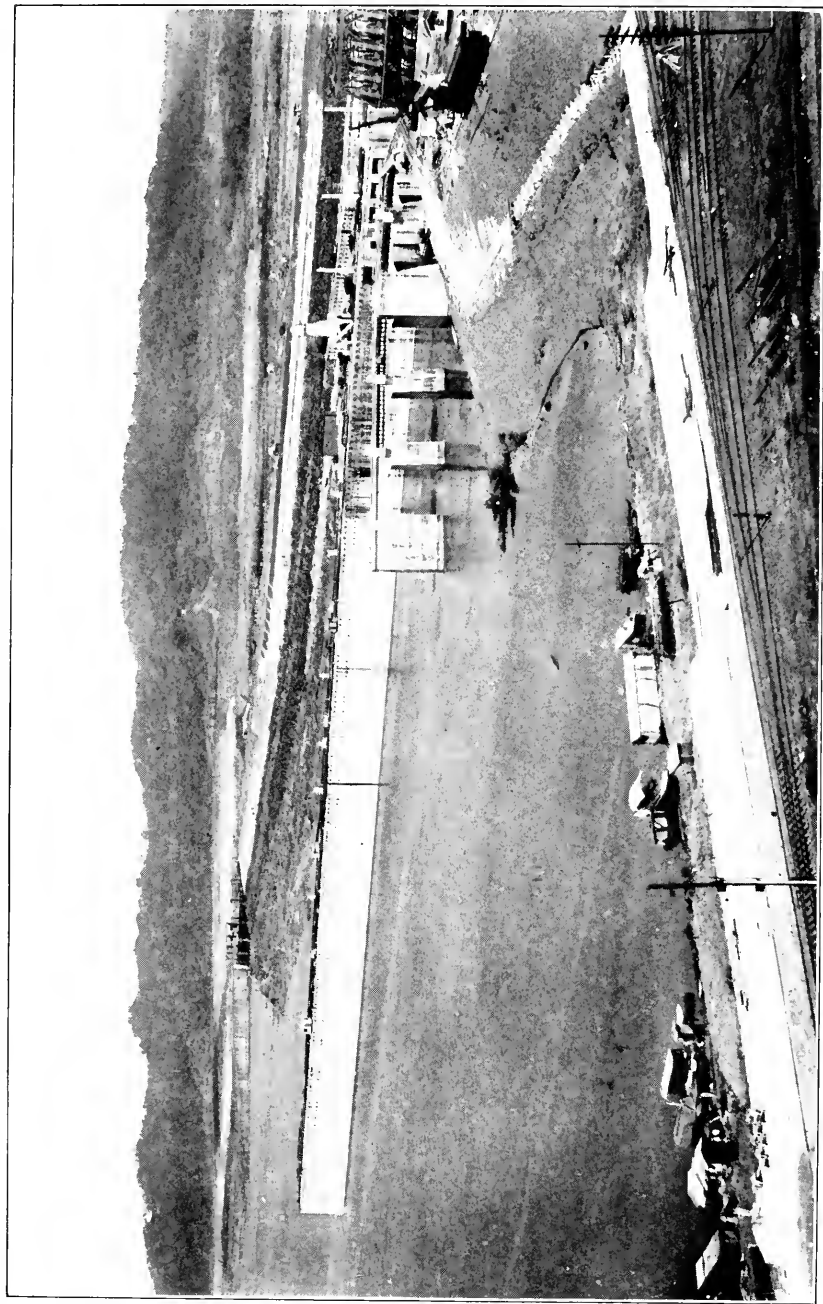
SEA LEVEL SECTION, NORTH OF GATUN LOCKS, SHOWING CAUSEWAY FOR TRACK LEADING TO DAM. ATLANTIC ENTRANCE IN THE DISTANCE. JULY 18, 1913.





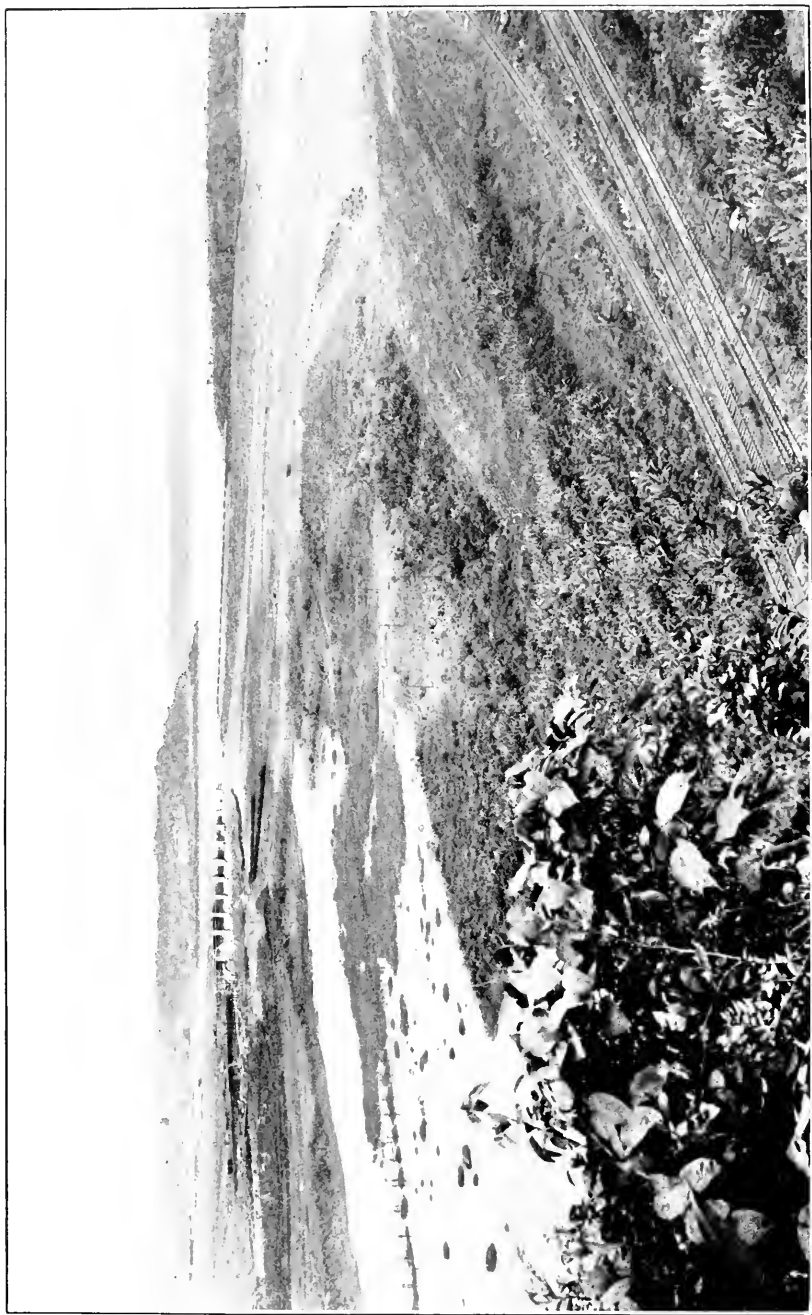
GATUN LOCKS, LOOKING SOUTH, SHOWING EMERGENCY DAMS AND LAKE. JUNE 20, 1913.





GATUN DAM AND LAKE APPROACH TO LOCKS. VIEW FROM WATER TOWER, LOOKING WEST. JULY 13, 1913.

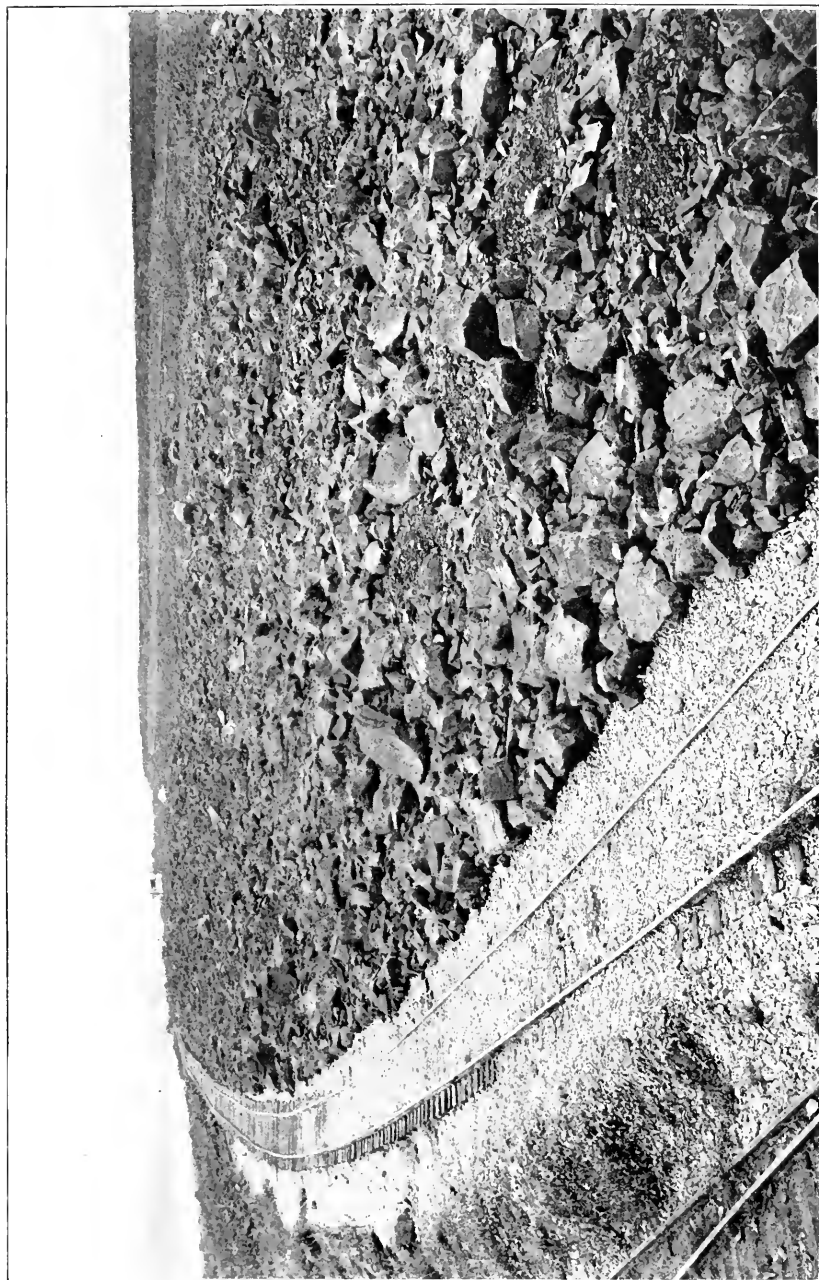




GATUN DAM. GENERAL VIEW FROM WEST HILL. MAY 26, 1913.

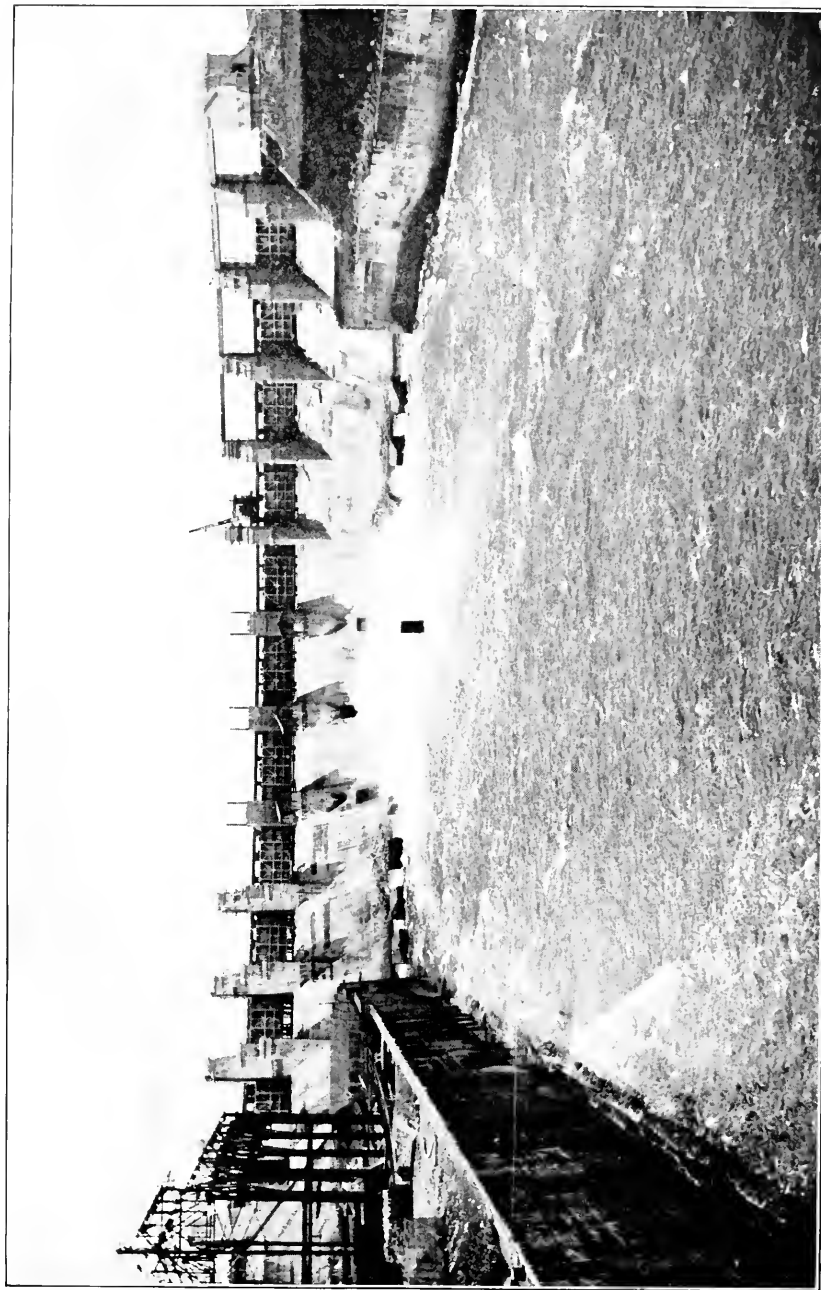






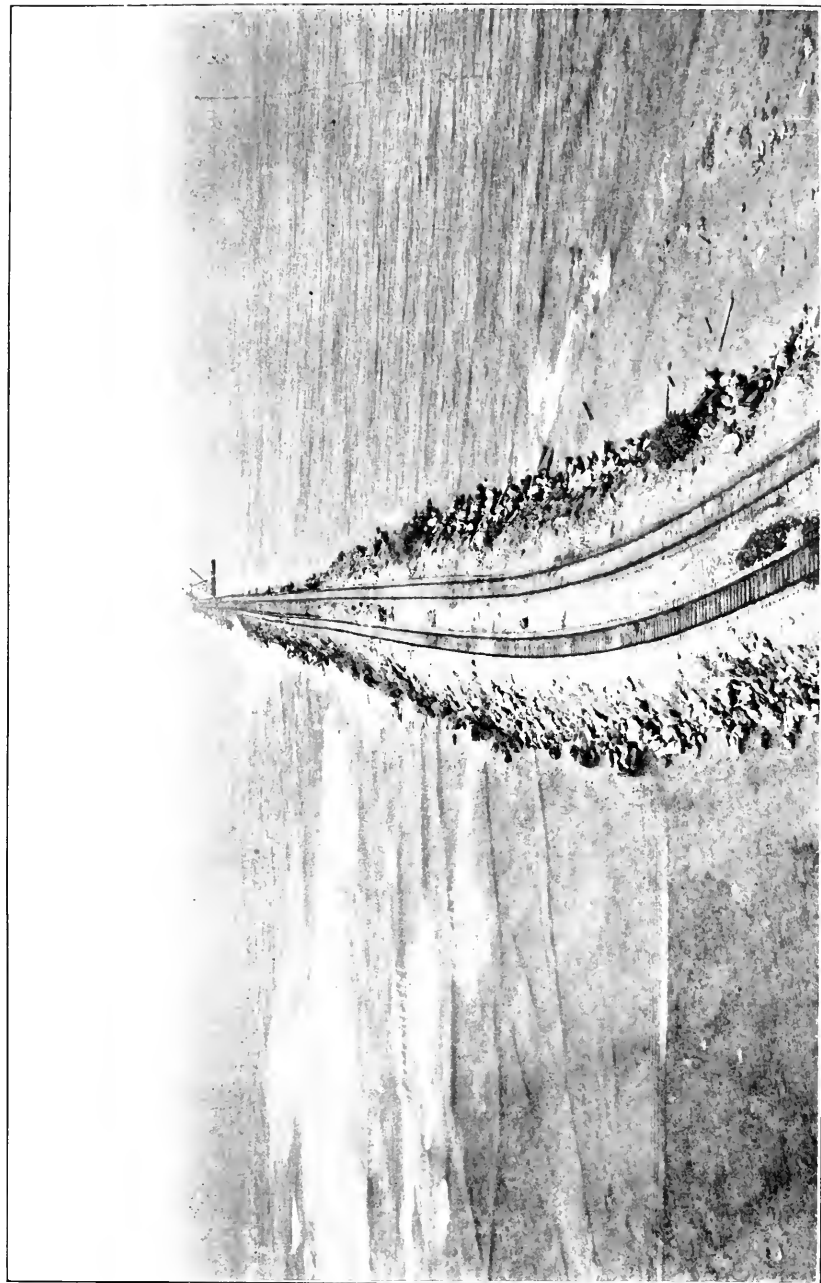
GATUN DAM. PAVING LAKE SLOPE. JULY 2, 1913.





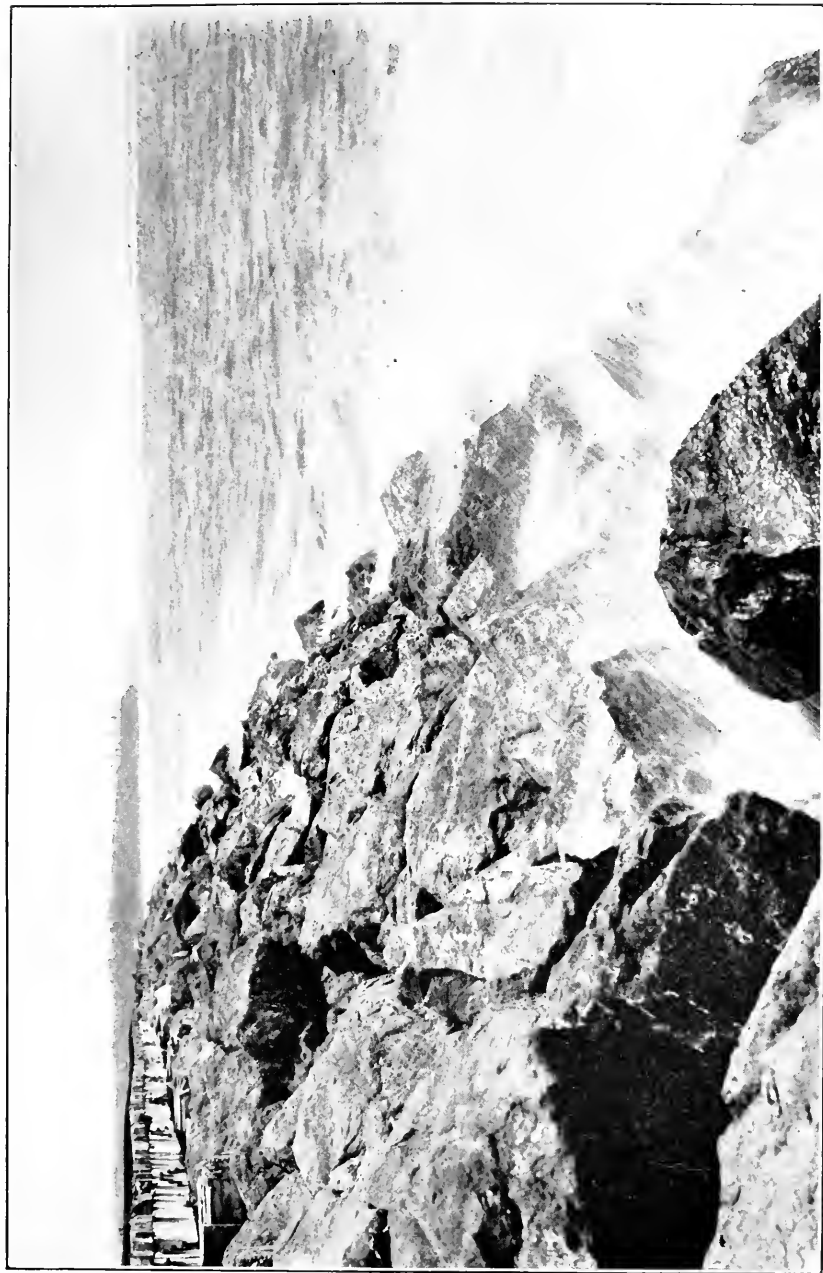
GATUN SPILLWAY DAM, SHOWING ALL CREST GATES IN POSITION, WATER RUNNING THROUGH TEMPORARY OPENINGS.  
JUNE, 1913.



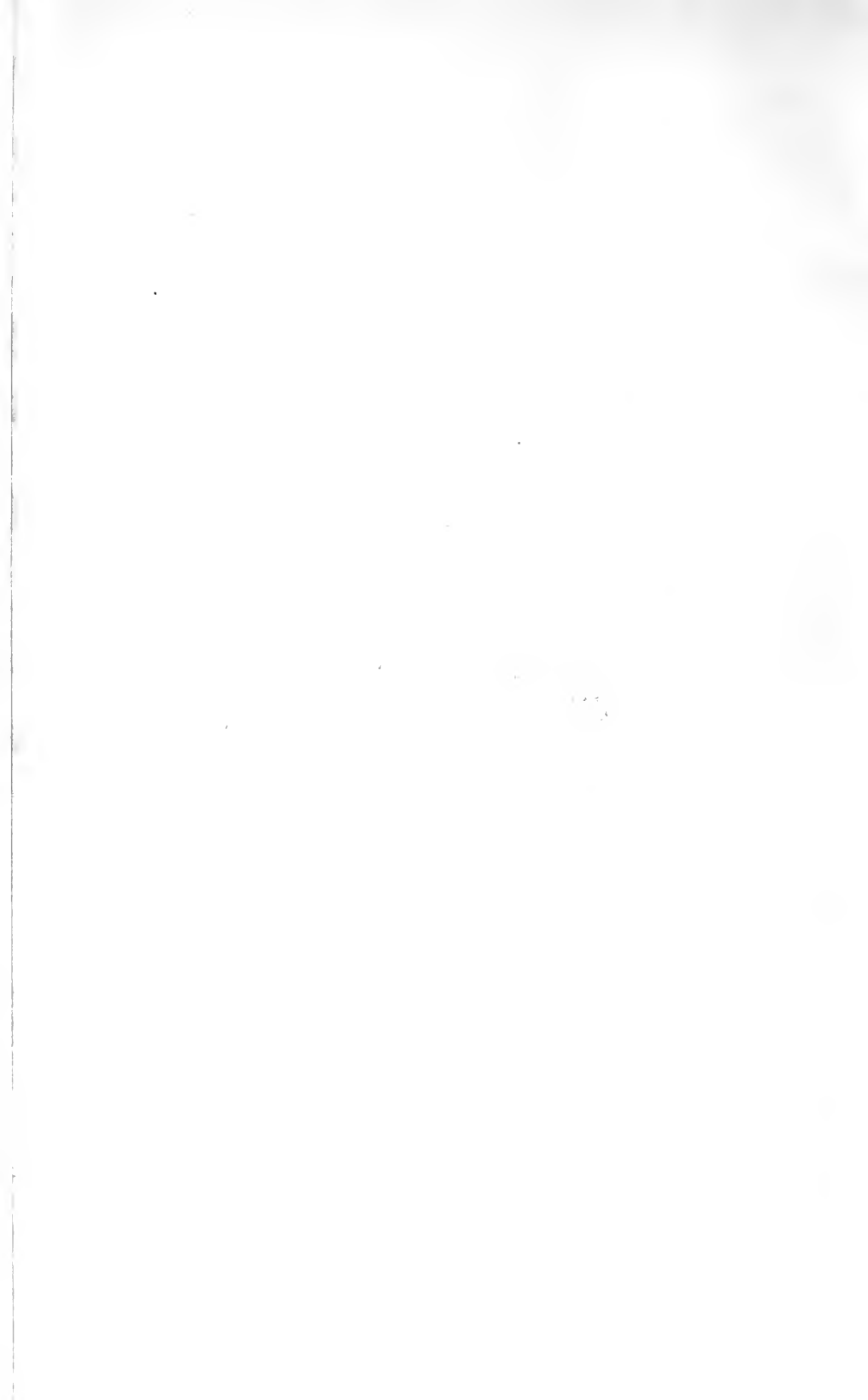


TORO POINT BREAKWATER. VIEW FROM LIGHTHOUSE, SHOWING DERRICK BARGES PLACING ARMOR ROCK FROM PORTO BELLO. JULY 12, 1913.





TORO POINT BREAKWATER. VIEW FROM STATION 3500, LOOKING TOWARD SHORE. BREAKWATER PRACTICALLY COMPLETED TO THIS POINT. JULY 12, 1913.





## APPENDIX C.

### REPORT OF LIEUT. COL. D. D. GAILLARD, CORPS OF ENGINEERS, UNITED STATES ARMY, MEMBER OF ISTHMIAN CANAL COM- MISSION, DIVISION ENGINEER, CENTRAL DIVISION.

#### ISTHMIAN CANAL COMMISSION, OFFICE OF DIVISION ENGINEER, CENTRAL DIVISION, *Empire, Canal Zone, July 21, 1913.*

SIR: I have the honor to submit the following report of operations in the central division for the fiscal year ended June 30, 1913:

The central division extends from the south toe of Gatun Dam to the north end of the lock site at Pedro Miguel, a total distance along the axis of the canal of 31.69 miles, and embraces the entire extent of the former Culebra and Chagres divisions, which are now known as the Culebra and Chagres sections of the central division.

The total amount of material excavated in the above territory during the fiscal years ended June 30 from 1904 to 1913 is given in the following tables:

FROM CANAL PRISM.

Fiscal year ended June 30—	Earth.	Rock.	Total.	Per cent rock.
	<i>Cubic yards.</i>	<i>Cubic yards.</i>	<i>Cubic yards.</i>	
1904.....	24, 024	36, 083	60, 107	60. 03
1905.....	397, 043	344, 601	741, 644	46. 46
1906.....	764, 327	742, 235	1, 506, 562	49. 27
1907.....	2, 288, 199	3, 282, 233	5, 570, 432	58. 92
1908.....	5, 078, 864	8, 380, 514	13, 459, 378	62. 27
1909.....	6, 151, 152	12, 291, 472	18, 442, 624	66. 65
1910.....	4, 570, 728	13, 235, 383	17, 806, 111	74. 33
1911.....	4, 530, 568	13, 949, 074	18, 749, 642	75. 49
1912.....	2, 702, 228	14, 335, 050	17, 037, 278	84. 14
1913.....	2, 549, 837	10, 089, 561	12, 639, 398	79. 83
Total.....	29, 056, 970	76, 686, 206	105, 743, 176	72. 52

FROM OBISPO DIVERSION.

1907.....	128, 001	45, 221	173, 222	26. 11
1908.....	240, 063	73, 448	313, 511	23. 43
1909.....	293, 745	329, 535	623, 280	52. 87
1910.....	26, 066	.....	26, 066	.....
1911.....	25, 684	17, 366	43, 050	40. 00
1912.....	26, 168	.....	26, 168	.....
1913.....	152, 376	3, 000	155, 376	1. 93
Total.....	892, 103	468, 570	1, 360, 673	34. 44

## OUTSIDE WORK.

Fiscal year ended June 30—	Earth.	Rock.	Total.	Per cent rock.
	<i>Cubic yards.</i>	<i>Cubic yards.</i>	<i>Cubic yards.</i>	
1907.....	13, 520	10, 840	24, 360	44.50
1908.....	64, 233	2, 140	66, 373	3.22
1909.....	.....	1, 873	1, 873	100.00
1910.....	33, 631	.....	33, 631	.....
1911.....	27, 467	2, 485	29, 952	8.30
1912.....	71, 269	8, 352	79, 621	10.00
1913.....	30, 350	5, 538	35, 888	15.43
Total.....	240, 470	31, 228	271, 698	11.49

## TOTAL EXCAVATION INCLUDING ACCESSORY WORK.

1904.....	24, 024	36, 083	60, 107	60.03
1905.....	397, 043	344, 601	741, 644	46.46
1906.....	764, 327	742, 235	1, 506, 562	49.27
1907.....	2, 429, 720	3, 338, 294	5, 768, 014	57.88
1908.....	5, 383, 160	8, 456, 102	13, 839, 262	61.10
1909.....	6, 444, 897	12, 622, 880	19, 067, 777	66.29
1910.....	4, 630, 425	13, 235, 383	17, 865, 808	74.08
1911.....	4, 583, 719	13, 968, 925	18, 552, 644	75.29
1912.....	2, 799, 665	14, 343, 402	17, 143, 067	83.67
1913.....	2, 732, 563	10, 098, 099	12, 830, 662	78.80
Total.....	30, 189, 543	77, 186, 004	107, 375, 547	71.88

The amount of material removed during each month since the United States assumed control, in May, 1904, is shown graphically on plate No. 93.

The following table shows the amount (place measurement) of material excavated monthly in the central division during the fiscal year ended June 30, 1913:

Month.	From canal prism.			Total, including accessory works.		
	Earth.	Rock.	Total.	Earth.	Rock.	Total.
	<i>Cubic yards.</i>	<i>Cubic yards.</i>	<i>Cubic yards.</i>	<i>Cubic yards.</i>	<i>Cubic yards.</i>	<i>Cubic yards.</i>
1912.						
July.....	253, 067	1, 077, 219	1, 330, 286	259, 147	1, 077, 219	1, 336, 366
August.....	170, 765	896, 535	1, 067, 300	197, 597	896, 535	1, 094, 132
September.....	139, 542	770, 314	909, 856	164, 742	770, 314	935, 056
October.....	146, 583	966, 837	1, 113, 420	153, 010	966, 837	1, 119, 847
November.....	145, 497	799, 822	945, 319	173, 249	802, 822	976, 071
December.....	95, 372	949, 246	1, 044, 618	125, 264	949, 246	1, 074, 510
1913.						
January.....	167, 771	949, 449	1, 117, 220	186, 131	949, 449	1, 135, 580
February.....	186, 827	803, 669	990, 496	190, 131	806, 669	996, 800
March.....	259, 571	924, 329	1, 183, 900	259, 571	924, 329	1, 183, 900
April.....	352, 546	825, 454	1, 178, 000	353, 646	825, 454	1, 179, 100
May.....	329, 661	566, 939	896, 600	354, 061	566, 939	921, 000
June.....	302, 635	559, 748	862, 383	316, 014	562, 286	878, 300
Total.....	2, 549, 837	10, 089, 561	12, 639, 398	2, 732, 563	10, 098, 099	12, 830, 662

The total amount of material excavated in the central division during the fiscal year, 12,830,662 cubic yards, has been exceeded during five previous fiscal years, 1908, 1909, 1910, 1911, and 1912.

The maximum monthly amount of material excavated in the central division during the fiscal year just closed was 1,336,366 cubic yards, removed in July, 1912. As stated in the last annual report, the output of March, 1909, will undoubtedly remain the highest

reached during the construction of the canal, as the work has now reached such a stage that the Chagres section is completed, except for a small amount of dredging, and the north half of the Culebra section is practically completed, so all operations will soon be confined to the south half of this section.

The maximum monthly amount of material removed from the canal prism since the commencement of operations was 2,012,469 cubic yards, excavated in March, 1911. The maximum yearly amount of material removed from the canal prism was excavated during the fiscal year ending June 30, 1911, amounting to 18,479,642 cubic yards.

Of the total amount of material excavated during the fiscal year, 12,828,086 cubic yards were removed by steam shovels, 1,800 cubic yards by locomotive cranes equipped with orange-peel buckets, 776 cubic yards by hand.

The material excavated by steam shovels is carried by dirt trains to dumps situated from 1 to 36 miles from the place of loading, the average haul varying from 10 to 12 miles.

#### REVISED ESTIMATE OF THE QUANTITY OF MATERIAL YET TO BE REMOVED.

A revised estimate of the quantity of material to be excavated in the central division after June 30, 1913, in order to complete the canal is given in the table below. Deducting the quantity of material excavated during the fiscal year 1912-13 (12,794,774 cubic yards), this estimate gives an increase of 9,280,237 cubic yards over the estimates submitted in the last annual report. The details of the new estimate are given in the following table:

Location.	Districts.				
	Chagres.	Empire.	Culebra.	Pedro Miguel.	Total.
	<i>Cubic yards.</i>	<i>Cubic yards.</i>	<i>Cubic yards.</i>	<i>Cubic yards.</i>	<i>Cubic yards.</i>
Inside prism lines.....	56,000	432,895	836,049	.....	1,324,944
Slides.....	.....	2,040,000	4,820,500	.....	6,860,500
Drainage cut.....	.....	7,700	48,000	.....	55,700
Silting, Chagres River.....	244,000	.....	.....	.....	244,000
Obispo diversion.....	.....	14,856	.....	.....	14,856
Total.....	300,000	2,480,595	5,704,548	.....	8,500,000

This very considerable increase is due to the development of new slides as the depth increased and to increased activity of slides already existing at the beginning of the fiscal year. In addition all excavation along the upper portion of the banks of the canal where slides had developed or were anticipated, being entirely outside of the canal prism, has been properly included in material removed on account of breaks and slides. This work was vigorously prosecuted during the fiscal year by from five to seven steam shovels and the quantity of material removed by them, as a preventive measure against slides and breaks, was 1,593,070 cubic yards.

Although the estimated yardage remaining has been materially increased by the new estimate, yet there is no reason to believe that either the ultimate time of completion of excavation in the central division or the ultimate cost of all excavation in this division, as sub-

mitted in the estimate of September, 1908, will be increased, for the reason that since that estimate was submitted the unit cost of excavation in the central division has been materially decreased and the average monthly output has been in excess of the quantity then estimated.

Taking the revised estimate of July 1, 1913, as a basis, there have been removed up to and including June 30, 1913, within the limits of the central division 107,196,455 cubic yards, and there remained to be removed 8,500,000 cubic yards, or less than 8 per cent, to complete all excavation within the limits of the central division. Of this amount, 8,200,000 cubic yards are in the Culebra section and 300,000 cubic yards in Chagres section.

#### BLASTING.

The total amount of blasted material excavated during the fiscal year was 8,621,833 cubic yards, which was 4,241,135 cubic yards less than in the previous year.

During the year 150 well or mechanical churn drills and 195 tripod rock drills were in operation.

The number of linear feet of holes drilled during the year was as follows:

Kind of drilling.	Linear feet.	Miles.
Tripod rock drills.....	2, 142, 300	405.74
Well drills.....	1, 650, 759	312.64
Hand drills.....	213, 139	40.35
Total.....	4, 006, 098	758.73

The average number of feet drilled per day per tripod rock drill was 47 feet at an average of operating labor cost of 8.92 cents per linear foot.

The average number of feet drilled per day per well drill was 28 feet at an average of operating labor cost of 6.89 cents per linear foot.

The quantity of explosives used during the year amounted to a total of 1,652.34 gross tons, which was 947.96 gross tons less than the amount used during the previous fiscal year. Of this amount 484,100 pounds were saltpeter dynamite of 60 per cent nitroglycerine, 2,372,950 pounds saltpeter dynamite of 45 per cent nitroglycerine, 318,150 pounds Trojan powder of 60 per cent strength, and 526,050 pounds of 45 per cent strength.

The average number of vertical holes fired per day during the year was 483, having an average depth of 18.3 feet. An average of 18.6 pounds of explosives was used per hole.

The average number of toe holes, i. e., holes drilled horizontally or nearly so, at the foot of a bank to secure greater breaking of material above, was 61, having an average depth of 15 feet. An average of 24 pounds of explosives was used per hole.

During the year 16,169 "dobe" shots or "mud caps" were fired in blasting material ahead of steam shovels not broken by the explosives

used in the drill holes, and in grading for track work, for which purpose 122,049 pounds of explosives were used.

The average number of pounds of explosives used in each "dobe" shot was 7.55, at an average cost per shot for explosives and blasting material of 90 cents.

The average number of cubic yards of material broken up per pound of explosive was 2.33.

The following blasting materials were used in connection with the dynamite and Trojan powder:

Detonators-----	177, 475
Tape fuse-----feet--	492, 225
Electric fuses:	
10-foot-----	1, 200
16-foot-----	14, 350
20-foot-----	42, 475
24-foot-----	72, 575
30-foot-----	818, 700
35-foot-----	129, 830
40-foot-----	93, 130
50-foot-----	9, 560
60-foot-----	1, 280
80-foot-----	368
Tape, insulating-----pounds--	3, 490½
Wire, connecting-----do--	195
Wire, lead-----feet--	615, 388

The same stringent rules covering the handling, storing, and use of explosives, in effect during previous fiscal years, were followed during the last year, the distribution of explosives being under the direct charge of a supervisor and always handled by the same engine and train crew.

All shooting, with the exception of "dobe" shots, is done by experienced blasting wiremen using current from the electric-power station at Empire. Occasionally "dobe" shots are fired by the current, but a majority are exploded by the use of detonators and safety fuse.

During the past year 3,701,250 pounds of explosives were used and no men were killed while handling dynamite.

Owing to the great care taken to prevent accidents but eight men in all have been killed by dynamite in the central division during the last four fiscal years, although during that period nearly 23,000,000 pounds of explosives were used.

#### STEAM SHOVELS.

The total number of steam shovels assigned to the central division at the close of the year was 42. These shovels were of the following sizes:

Class of shovel.	Capacity of dipper.	Number in service.
	<i>Cubic yards.</i>	
45-ton Bucyrus.....	1½	1
70-ton Bucyrus.....	3	6
95-ton Bucyrus.....	5	20
Do.....	4	10
Model 91, Marion.....	5	5

The highest daily, monthly, and annual records for shovels of each class are given in the table below :

Record.	45-ton Bucyrus.	70-ton Bucyrus.	95-ton Bucyrus.	Model 60, Marion.	Model 91, Marion.
Date of high daily record...	Feb. 5, 1908	Mar. 14, 1912	Mar. 22, 1910	Apr. 18, 1908	Jan. 21, 1909
Yardage, high daily.....	1,356	2,900	4,465	1,704	3,485
Shovel No.....	58	128	213	152	265
Date, high monthly record...	July, 1908	March, 1909	March, 1910	March, 1908	August, 1908
Yardage, high monthly.....	25,713	53,043	70,290	41,219	55,419
Shovel No.....	59	122	213	152	256
Number of days at work....	26	27	26	26	25
High annual record.....	105,740	300,872	543,481	.....	441,927
Shovel No.....	54	122	208	.....	264
Number of days at work....	131	254	295	.....	299

The following table shows the average performance of steam shovels for each month of the fiscal years ended June 30, 1908, 1909, 1910, 1911, 1912, and 1913:

Month.	Number work- ing days.	Cubic yards output per shovel.				Inches rainfall at—		
		Per day.	Per month.	Per hour.		Bas Obispo.	Empire.	Culebra.
				Under steam.	At work.			
1907.								
July.....	26	683.1	17,670	89.5	167.8	8.25	9.89	9.31
August.....	27	719.5	19,428	93.6	164.6	12.69	11.24	11.81
September.....	24	818.2	19,636	105.9	184.7	14.71	10.86	11.38
October.....	27	791.9	21,385	100.5	176.8	13.62	15.44	15.27
November.....	24	773.3	18,562	89.9	170.6	9.85	10.40	6.91
December.....	25	922.3	23,057	120.7	192.2	2.26	1.47	2.30
1908.								
January.....	26	1,039.5	27,031	131.2	208.4	.20	.75	.91
February.....	24	1,112.1	26,690	142.2	215.6	.11	.00	.01
March.....	26	1,159.4	30,146	147.2	221.6	.41	.41	.13
April.....	25	1,191.1	29,780	152.9	230.6	1.81	1.36	1.67
May.....	25	905.7	22,618	115.2	201.4	13.18	12.91	12.43
June.....	26	1,011.2	26,294	130.6	210.5	6.55	8.21	8.86
Fiscal year 1908.....	305	931.9	23,685	121.4	199.1	83.64	82.94	80.99
1908.								
July.....	26	1,073.2	27,902	137.9	206.9	9.14	11.79	13.23
August.....	26	1,119.6	29,300	144.7	216.2	10.23	8.11	7.58
September.....	25	1,180.2	29,585	140.8	202.9	5.76	9.75	15.18
October.....	27	1,185.3	32,228	148.3	214.1	9.42	8.85	8.91
November.....	23	1,154.8	26,693	145.8	222.5	6.95	4.46	5.26
December.....	26	1,210.5	31,474	151.8	232.4	6.63	5.09	4.40
1909.								
January.....	25	1,183.0	29,575	148.3	225.8	2.59	2.28	2.36
February.....	23	1,260.4	29,342	157.7	246.8	4.72	1.50	2.46
March.....	27	1,327.2	35,835	167.5	258.5	.45	.21	.15
April.....	25	1,283.7	32,120	160.9	242.5	5.90	3.33	2.56
May.....	25	1,182.9	29,507	148.5	229.3	12.98	7.84	9.44
June.....	26	1,242.9	32,315	156.3	240.5	11.71	7.72	7.36
Fiscal year 1909.....	304	1,198.9	30,371	150.4	227.6	86.48	70.94	79.49
1909.								
July.....	26	1,206.9	31,379	152.1	238.8	11.59	8.27	7.95
August.....	26	1,132.8	29,668	142.0	218.9	7.03	7.20	8.32
September.....	25	1,248.3	31,208	156.3	239.8	7.90	7.22	8.40
October.....	26	1,230.1	32,679	154.1	237.0	16.98	21.13	17.70
November.....	24	1,161.3	27,875	147.8	223.9	28.41	21.08	24.46
December.....	26	1,114.6	28,982	141.9	224.9	12.33	9.44	10.58
1910.								
January.....	25	1,252.3	31,307	150.5	238.5	1.24	.70	1.31
February.....	23	1,272.8	29,274	161.6	224.1	1.80	.76	.93
March.....	26	1,388.0	36,090	176.8	260.2	3.12	1.60	1.36

Month.	Number working days.	Cubic yards output per shovel.				Inches rainfall at—		
		Per day.	Per month.	Per hour.		Bas Obispo.	Empire.	Culebra.
				Under steam.	At work.			
1910.								
April.....	26	1,295.2	33,674	163.8	291.5	3.85	4.24	5.35
May.....	25	1,263.8	31,596	172.3	276.8	11.09	11.08	10.50
June.....	26	1,229.2	31,962	156.2	238.2	12.08	10.17	11.16
Fiscal year 1910.....	304	1,231.0	31,185	155.8	236.1	117.42	102.89	108.02
1910.								
July.....	25	1,231.4	30,786	156.8	231.4	17.00	12.60	16.38
August.....	27	1,330.1	30,224	168.1	242.5	10.66	10.08	10.11
September.....	25	1,340.2	33,505	169.7	244.2	12.24	8.99	10.09
October.....	26	1,294.2	33,649	163.3	237.0	12.90	12.57	13.51
November.....	24	1,225.2	29,403	153.6	228.4	16.90	8.85	10.81
December.....	26	1,170.2	30,424	149.4	228.3	13.11	9.06	11.86
1911.								
January.....	25	1,330.0	33,251	167.7	236.7	.11	.02	.02
February.....	23	1,436.8	33,059	180.5	253.1	.71	.55	.74
March.....	27	1,434.6	36,743	181.0	258.5	.38	.20	.05
April.....	24	1,370.6	32,895	172.3	248.1	4.01	3.93	4.89
May.....	26	1,293.0	33,482	161.6	235.4	14.53	13.74	14.86
June.....	26	1,316.2	34,200	164.4	249.2	6.98	5.92	4.25
Fiscal year 1911.....	304	1,314.4	32,635	165.7	241.1	109.53	86.51	97.57
1911.								
July.....	25	1,314.8	32,871	164.3	241.5	7.26	4.00	5.95
August.....	27	1,313.6	35,475	164.0	237.5	7.68	5.98	8.36
September.....	25	1,275.6	31,891	159.4	233.7	5.20	5.46	5.97
October.....	26	1,226.9	31,908	153.4	229.7	12.75	14.97	17.06
November.....	24	1,215.2	29,180	152.0	237.3	10.09	11.73	12.37
December.....	25	1,300.9	32,525	162.6	250.0	.97	.20	.31
1912.								
January.....	26	1,303.8	33,901	163.0	241.0	.06	.01	.00
February.....	24	1,348.9	32,174	168.6	252.1	1.11	.34	.33
March.....	26	1,414.9	36,786	176.9	258.3	.10	.01	.02
April.....	25	1,414.3	31,128	176.9	260.2	.77	2.64	3.14
May.....	26	1,340.0	34,839	167.2	252.7	7.94	6.21	8.15
June.....	25	1,355.8	33,855	169.1	263.8	11.64	8.50	7.57
Fiscal year 1912.....	304	1,318.7	33,038	164.8	246.5	65.57	60.05	69.23
1912.								
July.....	26	1,327.0	34,500	165.9	254.2	14.27	9.15	10.12
August.....	27	1,188.0	32,765	148.5	242.2	16.64	10.53	12.88
September.....	24	1,191.0	28,586	147.3	243.0	12.75	13.78	14.12
October.....	27	1,161.0	31,346	145.1	244.6	13.60	12.44	10.15
November.....	23.5	1,140.0	26,783	142.5	238.2	6.56	7.24	7.59
December.....	25	1,254.0	31,345	153.8	240.1	3.63	3.71	4.87
1913.								
January.....	26	1,232.0	32,042	154.0	249.9	2.65	1.67	1.57
February.....	23	1,117.0	25,691	139.6	244.3	.68	.79	.78
March.....	25	1,229.0	30,734	153.7	242.9	.08	.22	.57
April.....	26	1,108.0	28,803	138.6	231.6	1.07	.90	.71
May.....	26	873.0	22,718	109.2	197.4	15.13	11.74	11.74
June.....	25	858.0	21,448	107.2	202.8	8.02	11.48	9.10
Fiscal year 1913.....	303.5	1,142.5	28,897	142.1	235.9	95.08	83.65	84.20

The number of cubic yards per shovel per hour under steam averaged as follows:

Fiscal year ended June 30—

1908.....	121.40
1909.....	150.46
1910.....	155.80
1911.....	165.72
1912.....	164.78
1913.....	142.11

During the last fiscal year, on account of the practical completion of the north end of the central division and to the increased depth and lesser width in the Culebra Cut, the steam shovels were necessarily spaced more closely together and a decrease in individual efficiency therefore resulted.

In comparing the averages, daily and monthly, shown in the tables above it should be borne in mind that these averages are based on 8 hours per day, while work in most other places where steam shovels operate is carried on at least 10 hours per day.

The average output per shovel per day within the limits of the central division for each day since the commencement of operations by the United States is shown on plate No. 94.

### PLANT.

The following table shows the motive power, rolling stock, and construction equipment of the central division on June 30, 1913.

Item.	Transferred to division during fiscal year.	Transferred from division during fiscal year.	In service June 30, 1913.
Cars: Decauville (industrial).....		47	25
Dumps, steel—			
Western—			
10-yard.....		36	188
17-yard.....		29	113
Oliver—			
10-yard.....		20	196
17-yard.....		9	18
Goodwin, 24-yard.....			12
Dumps, wooden, Ingoldsby, 31-yard.....			12
Flat—			
Lidgerwood.....		86	1,531
Steel.....	20		63
Motor.....			1
Pay.....			1
Locomotive cranes:			
15-ton.....		1	
25-ton.....		1	2
100-ton.....		1	
Locomotives:			
Decauville, 0-4-0 type.....			1
Porter, 12 by 18, 0-4-2 type.....		1	
Belgian, 15½ by 19½, 0-6-0 type.....		2	1
Chiriqui, 16½ by 23½, 0-6-0 type.....		7	3
Baldwin—			
16 by 24, 4-4-0 type.....	1		3
19 by 24, 2-6-0 type.....		2	18
Cooke, 19 by 24, 2-6-0 type.....		2	76
Brooke, 20 by 26, 2-6-0 type.....			19
Pile drivers:			
Moonbeam.....			1
Swing circle.....			2
Plows, unloading:			
Right-hand.....			16
Left-hand.....		1	16
Spreaders:			
Jordan.....	1		2
Mann-McCann.....		1	10
Steam shovels:			
45-ton Bucyrus.....		1	1
70-ton Bucyrus.....		1	6
95-ton Bucyrus.....			30
Model 91-Marion.....		2	5
Track shifters.....			5
Unloaders: 60-ton Lidgerwood.....		1	21



## TRANSPORTATION.

The average number of locomotives working per day, and the total locomotive days during the year, were as follows:

Class of work.	Average per day.	Total number days.
Handling spreaders.....	6.61	2,007
Handling unloaders.....	9.35	2,837
Handling track shifters.....	3.14	953
Handling dirt and miscellaneous trains.....	105.97	32,163
Average per day and total.....	125.07	37,960

Of the locomotives shown as handling dirt and miscellaneous trains, an average of seven locomotives per day were used as pusher engines for getting the loaded trains up the inclines at either end of the Culebra Cut, as the depth of the canal having increased, these inclines are necessarily longer and steeper than in previous years. An average of six locomotives per day were used as helper engines in the canal in assisting the road engines in handling trains at steam shovels placed close together in excavating slides, and where grades required the service of more than one locomotive per train. The total number of locomotive days for the above work was 3,945.

The average number of cars loaded daily with excavated material, and the total number hauled during the year, were as follows:

Class of cars.	Average per day.	Total number handled.
Lidgerwood flats.....	2,064.30	626,514
Large steel dumps.....	159.46	48,396
Small steel dumps.....	545.43	165,538
Average per day and total.....	2,769.19	840,448

The largest number of cars handled in one day during the year was on July 11, 1912, when the following number were handled:

Lidgerwood flats.....	2,448
Large steel dumps.....	161
Small steel dumps.....	1,039
Total.....	3,648

At the close of the fiscal year the following trains were in service for the transportation of excavated material:

	Car trains.
65 Lidgerwood.....	20-21
6 large steel dump.....	27
5 small steel dump.....	35

A total of 76 trains, or less than two trains per shovel.

## TRACKS.

The amount of trackage in the central division was decreased by 31.4 miles during the year, making a total trackage in this division on June 30, 1913, of 156.06 miles. To provide running tracks and loading tracks for the steam shovels, approximately 163.65 miles of track were laid, 84.13 miles of track removed, and 1,233.08 miles of track were shifted on the dumps and in the Cut by manual labor and track-shifting machinery. In addition 796 frogs and switches were laid and 447 frogs and switches removed during the year. Of the above amount of tracks laid and removed it is estimated that from 35 to 40 miles of track, including the necessary frogs and switches, had to be taken up and relaid on account of the action of slides at various points in the canal, the pressure from which caused the bottom of the canal to heave and also caused lateral movement of the bottom, thus throwing the tracks out of alignment.

At least 10 miles of track in the division was buried by slides, so that it was impossible to recover the material in such condition as to be used for relaying.

The location and distribution of the track in the central division is given in the following table:

Name and location.	1910	1911	1912	1913
In canal prism (total feet).....	385, 884	402, 256	385, 100	277, 600
Tabernilla to Chagrecito.....	6, 529			
Tabernilla yard.....		7, 250		
Barbacoas-Caimito Junction.....		10, 870		
Caimito.....		3, 840		
East Mamei.....	2, 750			
Powderhouse Line-Santa Cruz.....	9, 860	10, 890	10, 600	10, 600
Santa Cruz Gravel.....		2, 480	1, 100	1, 000
Gamboia yard.....		11, 700	11, 700	11, 700
Bas Obispo.....	13, 914			
Old Gamboa and Las Cascadas.....				
High Line-Obispo diversion.....	29, 472	31, 442	23, 700	23, 400
Cotton Tree yard.....				7, 900
Gold Hill.....				17, 900
Paraiso.....	22, 150	19, 565	19, 100	23, 400
Old Panama R. R. Paraiso to Corozal.....		46, 214	45, 400	20, 000
Pedro Miguel.....	46, 980	52, 537	55, 000	49, 700
Pedro Miguel-Corozal main line.....				15, 200
Miraflores third track.....	3, 005	3, 005	3, 000	3, 000
Total east of canal.....	134, 660	199, 793	169, 600	183, 800
Juan Grande.....	10, 201			
Alligator curve.....	6, 700			
Gorgona.....	1, 800			
Gorgona yard.....	37, 172	9, 700	12, 900	9, 400
Matachin.....	9, 219	8, 800	5, 800	3, 700
Bas Obispo.....	4, 670	2, 230	900	1, 300
Las Cascadas and bridge No. 52.....	22, 300	23, 300	23, 400	21, 100
Whitehouse.....	18, 400	19, 511	16, 700	700
High Line—Whitehouse to Lirio.....	7, 273			
Whitehouse and Empire yard.....		5, 950	7, 700	1, 500
Cunette.....	3, 118			
Empire yard.....	44, 518	33, 923	41, 000	31, 000
Lirio.....	26, 100	22, 325	20, 400	17, 400
Culebra.....	11, 083	8, 220	4, 500	4, 700
Rio Grande.....	16, 855	17, 425	7, 400	10, 900
Cucaracha.....	5, 850	3, 800		
Paraiso.....	5, 346	5, 346	5, 300	5, 300
Total west of canal.....	230, 605	160, 530	146, 000	107, 000
Tabernilla prism dumps.....	3, 225			
Tabernilla.....	82, 895	55, 400		
San Pablo.....	1, 120	1, 120		
Caimito.....	985			
Mamei.....	5, 300			

Name and location.	1910.	1911.	1912.	1913.
New Panama R. R.:				
North of Juan Grande.....	8,028	1 29,580	17,800	16,100
South of Juan Grande.....	45,866	1 88,700	91,000	93,800
Gorgona.....	10,560	9,600		
Gorgona River dumps.....		2,700		
Point No. 3.....	13,500			
Matachin, west of canal.....	1,068			
Santa Cruz, east of canal.....	2,850			
Lirio.....	3,725			
Culebra.....		7,174	7,200	
Gold Hill.....	11,730	13,450	18,300	
Pedro Miguel.....				11,500
Power House.....				3,000
Miraflores.....	39,343	40,860	34,500	6,000
Balboa-Panama dumps-Ancon.....	76,800	93,230	120,300	125,200
Total dump tracks.....	306,995	341,814	289,100	255,600
Total track used by central division exclusive of Panama R. R. main line.....	1,058,144	1,104,393	989,800	824,000
Total track in miles.....	200.41	209.16	187.46	156.06

1 24,740 feet of this track owned by Panama R. R. but used and maintained by the central division.

## DUMPS.

The following table shows the disposition of all material excavated from the central division since the inception of work by the United States, including 12,830,662 cubic yards of material excavated during the fiscal year ended June 30, 1913:

Name of dump.	Wasted prior to July 1, 1913.	Wasted during fiscal year 1912-13.	Total wasted.
Gatun.....	5,374,300	45,441	5,419,741
Bohio.....	177,928		177,928
Chagrecito.....	147,718		147,718
Tabernilla.....	16,099,027		16,099,027
San Pablo.....	2,210,425		2,210,425
Caimito.....	1,701,414		1,701,414
Mamei.....	967,287		967,287
Juan Grande.....	1,275,642		1,275,642
Gorgona.....	778,612		778,612
Matachin.....	1,823,006		1,823,006
Incline No. 1.....	9,229		9,229
Santa Cruz.....	997,582		997,582
Point No. 3.....	18,177		18,177
Gamboa.....	184,792		184,792
Gamboa Dike.....		37,080	37,080
Chagres.....	434,086		434,086
Mandingo Dike.....		5,460	5,460
Bas Obispo.....	338,802		338,802
Camacho Dike.....		920	920
Bas Obispo Dike.....	5,174		5,174
Tunnel diversion.....	61,890		61,890
Obispo diversion.....	1,152,196	49,269	1,201,465
Sardnilla.....	4,054		4,054
Haut Obispo.....	35,525		35,525
Bridge No. 53.....	314,127		314,127
Las Cascadas.....	55,254		55,254
Buena Vista.....	74,045		74,045
White House.....	101,806		101,806
White Yard-Camacho diversion.....	32,756		32,756
Cunette.....	152,215		152,215
Empire.....	82,222		82,222
Cerro.....	176,998		176,998
Cableway.....	1,356		1,356
Culebra.....	1,298,745	334,358	1,633,103
Gold Hill and Lirio.....	1,860,003	284,755	2,144,758
Rio Grande.....	678,854		678,854
Cucaracha.....	48,438		48,438
Cartagenita.....	262,369		262,369

Name of dump.	Wasted prior to July 1, 1913.	Wasted during fis- cal year 1912-13.	Total wasted.
Paraiso.....	74,885	.....	74,885
Pedro Miguel town site.....	.....	16,318	16,318
Pedro Miguel.....	543,846	319,905	863,751
Double-track south tunnel.....	.....	8,201	8,201
Miraflores.....	13,314,791	1,288,262	14,603,053
Miraflores north incline.....	.....	15,545	15,545
Corozal.....	607,851	.....	607,851
Power-house fill.....	.....	84,760	84,760
Sosa.....	667,493	.....	667,493
Balboa.....	17,792,360	3,985,129	21,777,489
Bas Obispo crusher.....	184,234	.....	184,234
Naos Island Breakwater.....	781,931	653,242	1,435,173
Panama R. R.: Relocation, Caimito to Gamboa.....	12,394,572	.....	12,394,572
Relocation, Paraiso to Corozal.....	972,783	.....	972,783
Relocation dumps.....	1,783,194	4,376,080	6,159,274
East Mamei.....	180,432	.....	180,432
Culebra Swamp.....	713,290	.....	713,290
Point No. 4.....	611,240	.....	611,240
Pacific division.....	175,125	8,364	183,489
Balboa Y fill.....	350,835	440,725	791,560
Sosa Hill fill.....	.....	17,545	17,545
Ancon Sosa fill.....	671,756	392,699	1,064,455
Ancon Diablo fill.....	.....	25,998	25,998
Cristobal Mole.....	56,384	175,572	231,956
Panama R. R., relocation for riprapping.....	90,783	257,731	348,514
Miscellaneous.....	3,641,046	.....	3,641,046
Total.....	94,544,855	12,843,359	107,388,214

*Note.*—The total quantity of spoil disposed of by the central division exceeds the quantity excavated by 12,697 cubic yards. This amount is spoil hauled to central division dumps from Pedro Miguel Locks, fifth division.

All loaded trains from the canal are hauled out at either end of the Culebra Cut. The only central division dumps now being used for wasting material from the canal proper are those at Pedro Miguel, Miraflores, and Balboa, for trains run from the south end of the Cut, and the relocation dumps for trains run from the north end of the Cut over the Chagres River Bridge.

The average amount of material dumped per day at the larger dumps was as follows:

	Cubic yards.
Miraflores.....	6,409
Balboa.....	13,152
Relocation, Gamboa to Caimito.....	14,444

The material deposited at Balboa is serving a useful purpose in reclaiming from the ocean land which in time will be very valuable. The material dumped on the Naos Island Dike serves the twofold purpose of forming a protective dike for the ship channel and providing a means of rail and wagon road connection with the islands in Panama Bay.

During the fiscal year ended June 30, 1913, 90 acres were filled in, making a total of 474 acres in all reclaimed from the ocean at this point.

Between Balboa Y and Sosa Hills 54 acres of marshy land that it was impossible to drain properly were filled in during the year, 876,967 cubic yards of material from the canal being used for that purpose. According to present plans 13 acres more will be filled, making a total area of 139 acres of sanitary filling, which land will doubtless be utilized in connection with the operation of the canal.

It will be noted from the foregoing table that of the total amount excavated during the fiscal year, 12,343,554 cubic yards were wasted on central division dumps, the balance, 487,108 cubic yards, having been furnished other divisions and the Panama Railroad, as follows:

	Cubic yards.
Atlantic division, Gatun, for constructing toes of Gatun Dam-----	45,441
Panama R. R. relocation, for fills and riprapping embankment-----	257,731
Pacific division, for back fill of Pedro Miguel Locks, etc-----	8,364
Panama R. R., for construction of mole, Colon docks-----	175,572
<b>Total-----</b>	<b>487,108</b>

The following table shows the amount of trestle driven in the central division in connection with dumping operations during the fiscal years 1909, 1910, 1911, 1912, and 1913:

Name and location.	1909	1910	1911	1912	1913
Balboa (La Boca) dumps.....	6,539	4,074	6,273	1,360	.....
Pedro Miguel, left.....					178
Culebra dumps.....			920		
Gold Hill dumps.....				1,450	
Cardenas River dumps (Miraflores).....	1,742				
Haut Obispo to Bas Obispo.....	395				
Bas Obispo.....	1,256				
Near Bridge 52.....	178				
Canal connection, Matachin.....	780				
Santa Cruz.....	1,330				
Powder-house line, Santa Cruz.....	1,361				
Matachin to Santa Cruz.....	136				
Point No. 3.....	439				
Gorgona dump.....	15		448		
Relocation dumps.....		4,045	4,749		
Caimito to Tabernilla.....	505	110	868		
Tabernilla dumps.....	897		679		
Trestles in cut.....		169		828	
Obispo diversion.....	1,923	456	462	52	
Miscellaneous.....	1,131		260		
Redriven and repaired.....	882	2,260			100
<b>Total feet.....</b>	<b>19,509</b>	<b>11,114</b>	<b>14,659</b>	<b>3,690</b>	<b>278</b>
<b>Total miles.....</b>	<b>3.69</b>	<b>2.10</b>	<b>2.78</b>	<b>.70</b>	<b>.05</b>

Grand total, 49,250 feet (9.32 miles).

NOTE.—Of the trestle driven at Balboa dumps during the fiscal year 1912, 1,300 feet was double-track trestle for the Naos Island Dike.

During the fiscal year, work was in progress at a number of different places in the central division, and the names of the localities and the amount of work accomplished in each place during the fiscal year, together with the amount yet to be done, are given in what follows.

#### DIVERSIONS.

Due to the appearance of cracks in the sides of the Obispo diversion, which threatened to develop into slides which would break into the diversion at several points, it was decided to relocate the diversion farther to the east, which was done in three places.

In April, 1913, work was begun on a drainage ditch to carry off the rain water which accumulates at the old Culebra dumps, near Lirio. This work was completed June 26, 1913.

The following table shows the amount of material excavated at the different points of the relocated diversion, and also from the ditch to drain the old Culebra dumps:

	Cubic yards.
Relocated diversion around powder house slide-----	13, 056
Relocated diversion opposite the division office-----	39, 016
Relocated diversion around La Pita Point break-----	76, 004
Diversion to drain old Culebra dumps-----	27, 300
Total-----	155, 376

#### HAND EXCAVATION BY CONTRACT.

A contract was entered into between the Isthmian Canal Commission and Llewellyn Swain on December 6, 1910, which contract was transferred by Llewellyn Swain to B. B. Duncan, as subcontractor. This contract was for the excavation of about 112,450 cubic yards in the canal prism between stations 28 plus 1,000 and 28 plus 2,300, at a cost of 21½ cents per cubic yard. In May, 1912, a subsequent agreement was entered into between the contractor and the Isthmian Canal Commission establishing the price of 31½ cents per cubic yard on material excavated subsequent to March 22, 1912. On May 16, 1912, the contractor had removed 103,088 cubic yards, on which date the contractor signified his inability to complete the work, the remaining excavation to be done by the central division, any excess over and above 31½ cents per cubic yard to be paid for from the bond furnished by the contractor at the time of signing the contract. The central division removed in all 12,972 cubic yards remaining after the contractor relinquished the work, completing the work in July, 1912. For work done by the Isthmian Canal Commission for the completion of the Llewellyn Swain contract, the contractor is indebted to the commission to the amount of \$1,886.22.

#### CLEARING CHANNEL.

During the present fiscal year, it was noticed that portions of the canal channel which passes through the lake area between Gatun and Gamboa was, in portions, overgrown by bushes and small trees which had sprung up since the completion of the excavation in that territory. As the first division of the office of the chairman and chief engineer had forces employed in the construction of range lights in the lake area, and had the necessary floating and other equipment for performance of this work, the chairman assigned the work of clearing the channel to that division. This work was completed on June 17, 1913, a total of 250 acres having been cleared.

#### NAOS ISLAND DIKE.

This dike will extend from the shore at East Balboa to Naos Island, a distance of 3.29 miles from the mainland, and is being constructed for the purpose of shutting off the swift currents, which at flood tide flow across the canal channel nearly at right angles, causing a heavy

deposit of silt and tending to carry vessels out of the canal to the westward.

To construct this dike a pile trestle over 3 miles long was driven from the shore toward the island. From this trestle material from Culebra Cut was dumped, and as the trestle became filled the tracks were shifted laterally and the dike widened and used as a dump.

Up to June 30, 1913, the trestle had been entirely completed and filled, except for one stretch of a little over 600 feet. Great trouble has been experienced during the past year by the slipping of the rock filling. This movement has been the cause of much of the trouble during the last three years and resulted in continual settling of the stone filling for several months, when it gradually diminished and finally ceased. The total settlement at one locality on the dike during the past fiscal year aggregated over 125 feet.

Not a single foot of the trestle constructed during the last three years remains at present under the track for which it was intended, having moved to one side laterally as much as 300 feet.

Owing to the large tidal range the pressure on the bottom of the stone fill varies with the degree of submersion. The fluctuation of tidal levels aggregates at times as much as 16 to 18 feet a day, and this is a constant source of trouble, as the dike almost always "goes out" when the surface of the water is at the lowest elevation, at which time the pressure, as stated above, on the bottom of the dike is a maximum.

So large is the movement that actual observations have shown in recent months that the quantity of stone required to complete the dike up to the present height was at least 10 times the theoretical quantity which would have been required had the bottom been unyielding.

The photographs taken during the present fiscal year indicate more clearly than words can do the character of the bottom on which this breakwater is being constructed.

The construction of this dike has proved to be one of the most difficult pieces of construction work ever attempted in the central division, yet owing to the fact that a very large supply of suitable material has been available up to the present time the cost has not been excessive, amounting to about \$17.29 per linear foot from the commencement of operations up to July 1, 1913.

The total cost of the dike up to July 1, 1913, has been \$398,529.70, or about \$22.94 per linear foot. Of this amount \$70,558.01 has been charged to the Pacific division.

#### SLIDES AND BREAKS.

The progress of excavation in the Culebra Cut during the fiscal year ending June 30, 1913, has been rendered more difficult on account of slides and breaks in the banks of the canal, than ever before. It was anticipated that this trouble would increase as the depth of the Cut increased, and that this anticipation was realized is shown by the total amount of material removed on account of breaks and slides for the fiscal year ending June 30, 1913, which was 5,899,200 cubic yards.

The only method of treatment for slides, which has proven effective once they have developed, is to excavate and haul away the moving material, until the slide comes to rest at the angle of repose for

the particular material then moving. This angle of repose varies greatly in different parts of the Cut, depending not only on the character of the material involved in the slide, but also upon the inclination of the strata and the angle at which the formation crosses the canal.

At the southern part of Cucaracha slide the angle of repose equals one vertical on two horizontal, while on the west bank of the Cut, near the town of Culebra, the argillaceous sandstone is still moving slightly on a slope a little steeper than one vertical to five horizontal. The flat slopes of the banks in the deepest part of the Cut explain the large amount of material added by slides and breaks, as the original estimates made by the International Board of Consulting Engineers are based on side slopes in the deepest parts of the Cut of three vertical on two horizontal.

Of the number of slides and breaks described in the last annual report one of the most noteworthy is the Cucaracha slide, which began to give trouble to the Americans in July, 1905, and from which about 4,000,000 cubic yards have been excavated to date. It covers a total area of 47.1 acres, but has been less active in recent weeks than was the case some months previously.

Details regarding all of the principal slides in the central division, all of which are confined to the Culebra section of this division, are given in the following table:

*Estimate of slides outside of slope lines for year ending July 1, 1913, showing total estimates of material to date.*

Location.	Date when slide first developed.	Cubic yards excavated year ending July 1, 1913.	Cubic yards of material excavated to date.	Cubic yards of material remaining.	Area of slide in acres.
East side:					
Bas Obispo.....	September, 1910.....	.....	117,000	70,000	2.8
Haut Obispo.....	September, 1908.....	.....	18,000	.....	.6
West side, Buena Vista.....	November, 1908.....	.....	162,000	.....	3.3
East side:					
Buena Vista.....	May, 1912.....	48,000	48,000	20,000	1.2
Las Cascadas.....	February, 1908.....	.....	508,000	80,000	11.5
Whitehouse.....	October, 1908.....	29,400	509,000	100,000	6.0
West side, Whitehouse yard.....	June, 1912.....	45,000	45,000	30,000	1.0
East side:					
Powder house.....	October, 1909.....	97,000	543,000	70,000	5.8
North La Pita.....	September, 1912.....	181,100	181,100	30,000	1.7
Lower La Pita.....	May, 1910.....	.....	30,000	.....	.3
Upper La Pita.....	December, 1909.....	.....	20,000	.....	1.7
West side, Cunette.....	September, 1910.....	.....	67,000	.....	.9
East side, Empire.....	May, 1912.....	539,500	933,700	280,000	20.0
West side:					
Division office.....	May, 1910.....	48,000	258,000	20,000	2.6
Lirio.....	April, 1912.....	209,000	221,200	60,000	3.6
Culebra.....	October, 1907.....	1,922,700	8,687,600	2,390,000	68.0
East side:					
Culebra.....	January, 1907.....	1,676,300	5,966,200	2,000,000	55.0
Cucaracha.....	July, 1905.....	1,006,900	3,859,500	1,500,000	50.0
West side, Contractors Hill.....	July, 1908.....	5,000	221,000	200,000	2.0
East side:					
Cucaracha village.....	September, 1911.....	88,000	231,100	.....	4.0
Paraiso.....	March, 1907.....	.....	385,000	.....	5.7
Pedro Miguel.....	January, 1913.....	3,300	3,300	10,500	.2
Total.....	.....	5,899,200	23,009,700	6,860,500	247.9



## COST OF EXCAVATION.

The average cost of the various items of expense in connection with excavation is shown in the following table, giving comparison with the fiscal years 1908, 1909, 1910, 1911, 1912, and 1913:

Class of work.	1908	1909	1910	1911	1912	1913
Loading, steam shovels.....	\$0.1150	\$0.1001	\$0.0888	\$0.0717	\$0.0681	\$0.0863
Loading, hand.....		.3993	.3442	.2567	.3056	.3150
Drilling and blasting.....	.1413	.1149	.1190	.1048	.1157	.1069
Transportation.....	.1854	.1452	.1522	.1414	.1331	.1740
Dumps.....	.1344	.0911	.0657	.0541	.0479	.0645
Tracks.....	.1190	.0838	.1001	.1014	.0885	.0966
Division office and supervision.....	.0163	.0114	.0150	.0120	.0142	.0128
General surveys.....	.0008	.0001	.0003	.0002		
Clearing site.....	.0004	.0048	.0046	.00005	.0001	
Division structures.....	.0002	.0012	.0013	.0005	.0003	.0003
Drainage and sumps.....			.0052	.0038	.0041	.0091
Total division cost.....	.7128	.5517	.5416	.4880	.4707	.5505
General expense and administrative expense.....	.1882	.1049	.0646	.0457	.0361	.0355
Plant arbitrary.....	.1300	.1300	.1300	.1000	.0395	.0040
Total.....	1.0310	.7866	.7362	.6337	.5463	.5900

It will be noted that the cost is higher than in previous years, but it is not considered excessive. The increased depth of the canal and the heavier grades over which the transportation department has had to work, as well as the unusually heavy rains, has caused a material increase in the cost.

## COAL AND FUEL OIL CONSUMED.

The total quantity of coal used during the fiscal year amounted to 153,923 long tons. Coal is the only fuel used on the division except at the following pumping stations, at which points 15,271.63 barrels of fuel oil were used during the fiscal year: Cucaracha, Camacho, and Gorgona.

## AIR AND WATER SERVICE.

During the fiscal year, in furnishing air connection for drills and other purposes, 2,593,416 feet of pipe were laid, while 2,069,250 feet of pipe were removed. The central division maintained the air mains leading from the air compressors and paralleling the canal on the east and west banks.

In furnishing water connections for steam shovels, orange peel and clam shell cranes, locomotives, and for other purposes 1,755,995 feet of pipe were laid, while 1,858,114 feet of pipe were removed.

## MUNICIPAL WORK.

During the fiscal year ended June 30, 1913, municipal work was carried on as in the past, the principal items of work performed being as follows:

Water:		
Pipe laid	feet	5,433
Pipe removed	do	6,990
Pipe relaid	do	6,665
House connections made	do	21
Meters:		
Installed	do	9
Removed	do	1
Oil pipe installed	do	3,969
Sewer:		
Pipe laid	do	3,543
Pipe removed	do	188
Pipe relaid	do	785
House connections made	do	4
Sanitary work:		
Regrading ditches	linear feet	602,578
Ditches dug	feet	4,698
Ditches cleaned	do	1,327,676
Tile drains laid	do	6,426
Concrete gutters made	do	3,852
Concrete ditches cleaned	do	847,852
Clearing	square yards	908,331
Miscellaneous: Cleaning around reservoirs	do	123,462

## ROAD BUILDING.

The construction of what is known as the Empire-Chorrera Road was continued during the fiscal year. As soon as the actual construction was accomplished, the convicts engaged in this work were transferred to other work, and a small force of paid labor established to continue the crushing and laying of rock, placing of screenings, rolling, and other work necessary for the completion of the road to the Zone boundary. The work accomplished was as follows:

Clearing	acres	6
Cubic yards of excavation		20,752
Cubic yards of earth placed in fills		17,317
Cubic yards of masonry in culverts and bridges		413
Linear feet of 18-inch concrete pipe manufactured		470
Linear feet of Telford base laid		6,128
Linear feet of crushed rock placed		19,432
Linear feet of extra screenings placed		7,562

On November 27, 1912, work was begun on a 16-foot macadam road from Gamboa to a point on the Las Cascadas Plantation Road about 3,600 feet from the east end of the Empire Suspension Bridge, a total distance of approximately 5 miles and 380 feet. Prison labor is to be used in the construction of this road, and for the purpose a stockade was erected at Gamboa for housing the convicts previously engaged in the construction of the Empire-Chorrera Road, who were transferred to this work.

The following work was performed on the construction of the Empire-Gamboa Road during the fiscal year 1913:

Clearing .....	acres..	11. 65
Excavation.....	cubic yards..	26, 484
Masonry.....	do.....	547. 5
18-inch pipe .....	linear feet..	534
Berming for Telford.....	do.....	4, 075
Telford.....	do.....	2, 925
Subgrading and ditching complete for 7,600 linear feet.		

The Empire-Paraiso Road was relocated for a distance of 5,608 feet and constructed. This was necessary on account of slides along the east bank of the canal.

In the village of Culebra 2,370 feet of road were reconstructed on account of slides on the west bank of the canal.

At Lirio camp 253 feet of road were constructed.

For the protection of the roads and for the comfort and convenience of employees during the dry season, the oiling and rolling of roads was authorized by the acting chairman and chief engineer on December 3, 1912. The length of road oiled and rolled in the different towns is as follows:

Empire .....	linear feet..	14, 398
Culebra .....	do.....	12, 700

During the fiscal year, 16,323 linear feet of the Gorgona-Bas Obispo Road were rolled and 12,240 linear feet of this road resurfaced.

The community closets heretofore in use at Golden Green village were discontinued and sewers substituted therefor. In this work 1,940 feet of sewer pipe was used.

For fire protection at bridge 57½, 390 feet of 3-inch water pipe was laid and four fire plugs installed.

The following work was accomplished in connection with the maintenance of roads, the maintenance of cinder paths having remained under the supervision of the quartermaster's department:

General repairs .....	square yards..	813, 421
Ditches cleaned .....	linear feet..	629, 509
Ditches excavated.....	do.....	15, 200

The above includes the resurfacing and rolling of the Empire-Paraiso Road and the resurfacing, reditching, and rerolling of the Las Cascadas Plantation road.

#### WATERWORKS.

In connection with the water supply to the different settlements the use of Rio Grande, Camacho, and Carabali reservoirs and the operation of pumps at Paraiso, Cucaracha, Gorgona, and Gamboa was continued throughout the year. Water was also condensed at the above stations and at the condensing plants at Las Cascadas and Bas Obispo.

In addition to the above, pumps were operated at Lirio, Sardanilla River, Gamboa, and Gorgona shops throughout the year; these pumps supply water for the operation of shops and for other canal construction purposes. Approximately 550,000,000 gallons of water were

consumed by the central division from the Rio Grande Reservoir, which is operated by the fifth division. The following table shows in detail the quantity of water consumed, pumps in operation, etc.:

Pump stations.	Water pumped.				
	Number of pumps—		Total gallons.	Number days in operation.	Daily average gallons.
	In service.	At work, daily average.			
Paraiso.....	2	1	49,760,000	365	136,300
Cucaracha.....	3	2	156,919,898	365	429,918
Camacho.....	2	2	229,849,413	365	629,724
Lirio.....	3	2	146,000,000	365	400,000
Sardanilla River.....	2	1	219,000,000	365	600,000
Gorgona.....	4	2	295,404,614	365	809,328
Gorgona shops.....	2	1	52,000,000	104	500,000
Gamboa.....	3	2	633,500,000	304	2,083,881
Total.....	21	13	1,782,433,925	325	5,588,823
Consumed from Rio Grande Reservoir direct.....			1,550,000,000	365	1,056,849
Grand total consumed.....			2,332,433,925		6,390,320

Pump stations.	Water condensed.				
	Number of pumps—		Total gallons.	Number days in operation.	Daily average gallons.
	In service.	At work, daily average.			
Cucaracha.....	1	1	300,365	365	826
Camacho.....	1	1	603,771	365	1,654
Gorgona.....	1	1	1,131,734	365	3,100
<i>Condensers.</i>					
Las Cascadas.....	1	1	704,050	365	1,929
Bas Obispo.....	1	1	396,870	365	1,086
Total.....	5	5	3,136,790	365	8,595

<sup>1</sup> The total quantity of water consumed from Rio Grande Reservoir was 756,679,898 gallons; 550,000,000 gallons were used direct from main and 206,679,898 gallons were pumped at Paraiso and Cucaracha stations.

During the fiscal year 23,129,679 gallons of water were pumped and 171,312 gallons of condensed water furnished to Camp E. S. Otis, and 19,020,470 gallons pumped and 74,073 gallons of condensed water furnished to Camp Elliott.

During the fiscal year the summit of drainage in the Cut was at a point in the canal opposite station 1750. Water south of this point is drained into the Pacific Ocean by gravity through a culvert in the Pedro Miguel Locks.

The gravity drainage south of summit was interrupted on account of slides to such an extent that it was necessary to pump water over summit to north drainage ditch. For this purpose one centrifugal pump, 17-inch discharge, capacity 12,000 gallons per minute, and one centrifugal pump, 12-inch discharge, capacity 5,000 gallons per minute, were installed, and commenced operation just north of station 1804 on May 3, 1913.

The sump pumps installed at the north end of the Pedro Miguel Locks were continued in operation during the year. All water entering the Cut north of this drainage summit is pumped into the Chagres River by sump pumps at the Bas Obispo Dike.

At the close of the fiscal year the following pumps were in service for this purpose:

Three duplex pumps, 16 by 22 by 18 inches; capacity, 4,200 gallons per minute each.

Two Wagner pumps, 16 by 8 by 12 inches; capacity, 445 gallons per minute.

One Worthington centrifugal pump, 24-inch discharge; capacity, 18,000 gallons per minute.

Two French centrifugal pumps, 17-inch discharge; capacity, 7,000 gallons per minute each.

Two French centrifugal pumps, 17-inch discharge; capacity, 7,000 gallons per minute each, were installed during August, 1912.

#### LABOR CONDITIONS.

During the fiscal year the labor situation was entirely satisfactory, the supply of laborers equaling the demand during the year. The majority of the laborers employed in the central division are West Indian negroes. The average number of laborers at work during the fiscal year just ended was 6,701.

#### CHANGES IN ORGANIZATION.

On July 1, 1912, Empire shops, including the gold and silver personnel, was transferred to the mechanical division. These shops performed repairs to steam shovels, drills, etc., together with sundry other repair and maintenance work necessary in the central division.

On July 1, 1912, the Las Cascadas wrecking outfit was transferred to the mechanical division at Gorgona, the central division retaining the wrecking outfit at Pedro Miguel as heretofore.

On August 19, 1912, the Chagres district was abolished; the position of superintendent of construction having jurisdiction over this section was likewise abolished, through resignation, and the title of this section was changed to the relocation dumps and placed in charge of a general foreman at \$225 per month.

On October 1, 1912, the following changes in the dividing line between districts were put into effect:

Empire district to extend from the Chagres River to station 1760.

Culebra construction district from station 1760 to Pedro Miguel Locks, including incline tracks at Paraiso and the Isthmian Canal Commission main line adjacent thereto, as far south as a point opposite the north face of the northeast wing wall at the Pedro Miguel locks.

Pedro Miguel construction district to comprise the central division tracks south from a point opposite the north face of the northeast wing wall of Pedro Miguel Locks and the Miraflores and Balboa dumps.

Owing to the program outlined for excavation work in Culebra Cut, it was deemed advisable to extend the limits of Empire district on the west side of the canal to include the large slide west of Culebra, which was done under date of September 26, 1912.

On November 1, 1912, the jurisdiction of the general yardmasters in the canal was changed to correspond with the limits of the construction districts—i. e., Empire and Culebra.

On November 16, 1912, it was found necessary in the interest of efficiency and economy to concentrate the timekeeping of the Culebra and Empire construction districts in the office of the division engineer, and the district time offices were abolished in these two districts.

On January 15, 1913, the above program was extended to include the timekeeping force of the relocation dumps, one man being assigned to look after routine work in that office.

#### CHANGES IN PERSONNEL.

On July 1, 1913, Mr. W. H. Bates, superintendent of steam shovel repairs, and J. H. Moriarty, assistant superintendent of steam shovel repairs, were transferred to the mechanical division.

On August 19, 1912, J. W. Sneed, superintendent of construction, Chagres district, resigned.

On August 26, 1912, J. M. McNeill, assistant superintendent of transportation, resigned.

On August 6, 1912, Fred L. Huff, assistant superintendent of construction, Pedro Miguel district, resigned.

On August 19, 1912, Rance Ferguson was appointed general foreman in charge of the relocation dumps, vice J. W. Sneed, resigned.

December 1, 1912, George W. Morrell, chief dispatcher, was appointed assistant superintendent of transportation.

On December 1, 1912, W. T. Snyder was appointed chief dispatcher, vice George W. Morrell, promoted.

On October 20, 1912, W. M. McCoy, chief accountant, resigned.

On December 23, 1912, Rufus K. Booth was appointed chief accountant, vice W. M. McCoy, resigned.

On February 2, 1913, Joseph Little, superintendent of construction, Culebra district, resigned.

February 3, 1913, M. W. Tenny, assistant engineer, was appointed superintendent of construction, vice Joseph Little, resigned.

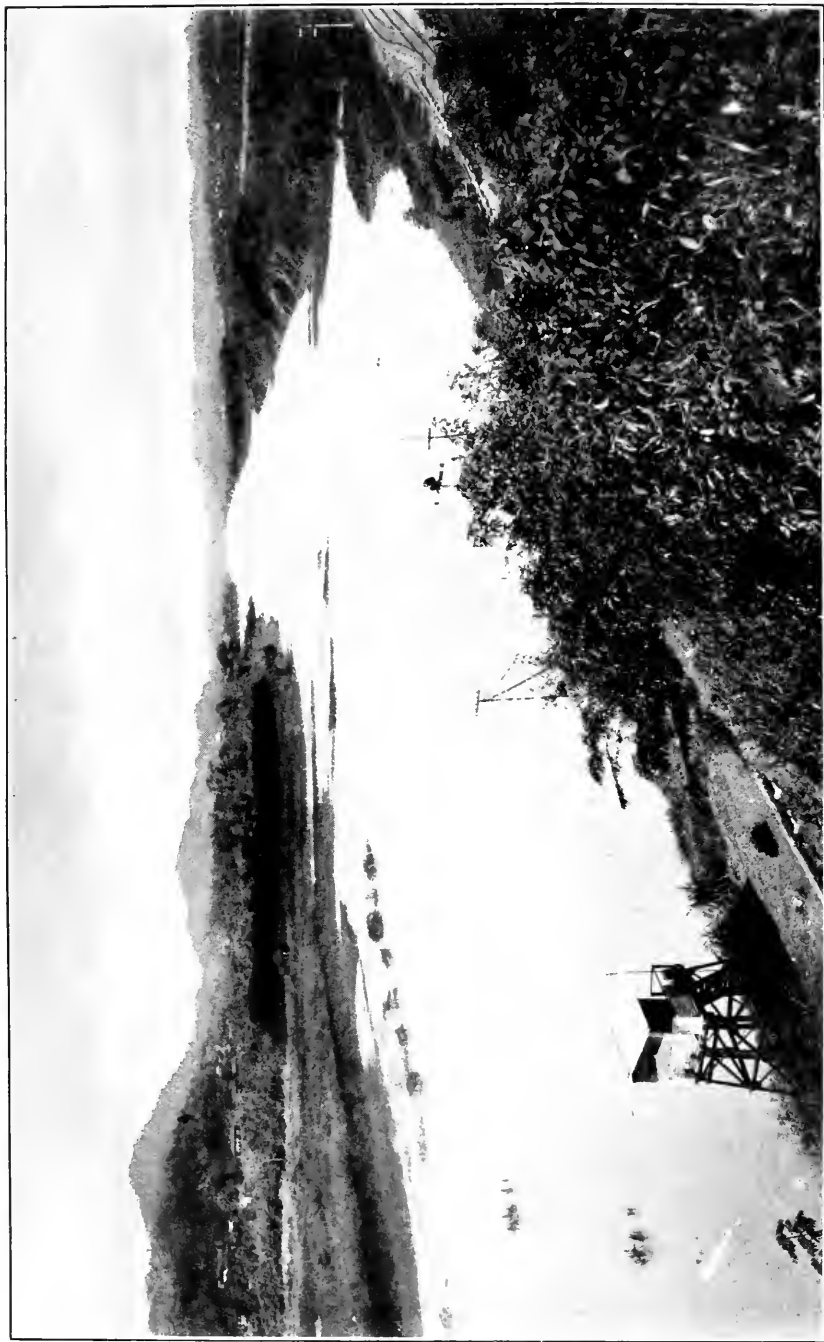
March 1, 1913, Wilbor D. Stanton was appointed assistant engineer, vice M. W. Tenny, promoted.

March 30, 1913, George W. Morrell, assistant superintendent of transportation, resigned.

Respectfully submitted.

D. D. GAILLARD,  
*Lieutenant Colonel, Corps of Engineers,  
U. S. Army, Member Isthmian Canal Commission,  
Division Engineer, Central Division.*

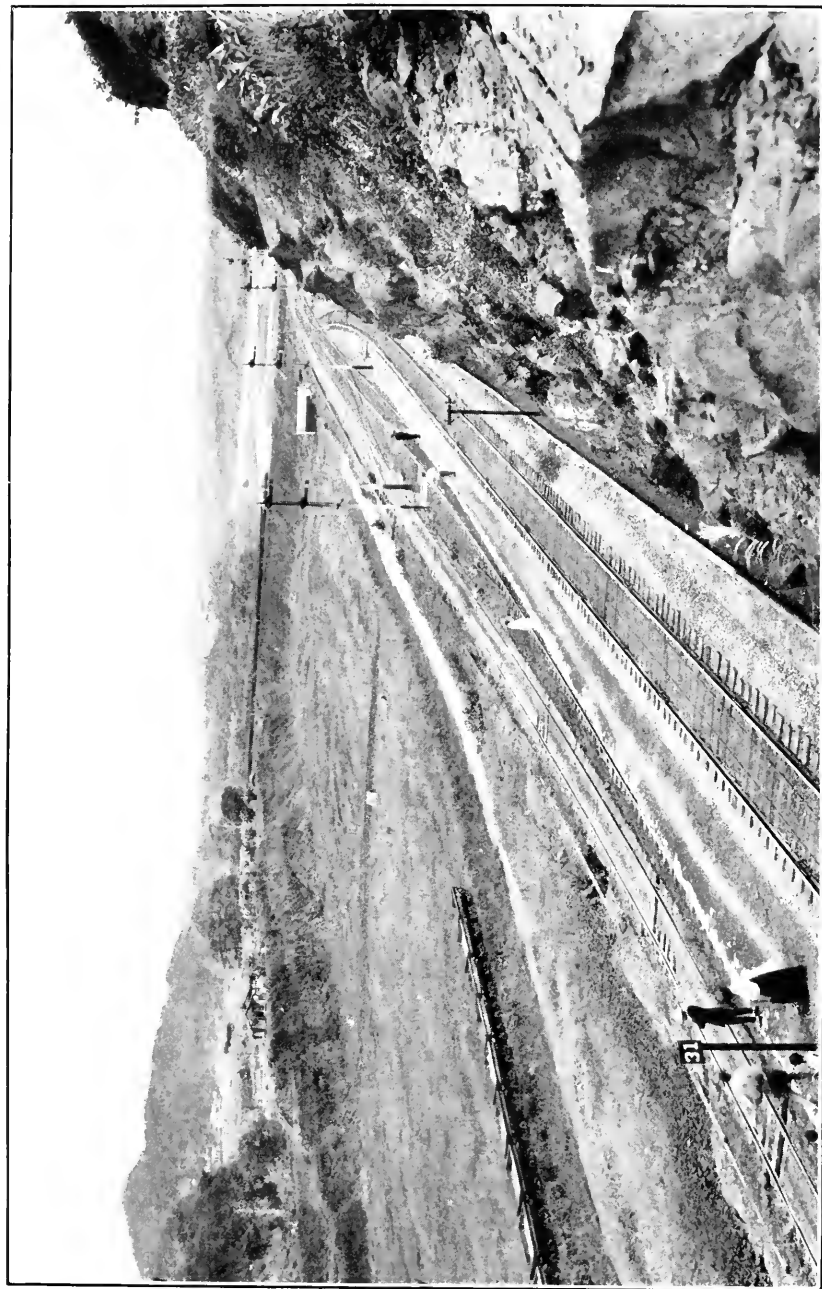
Col. GEO. W. GOETHALS, U. S. Army,  
*Chairman and Chief Engineer, Culebra, Canal Zone.*



CANAL CHANNEL. LOOKING NORTH FROM POINT NO. 1, NEAR GAMBOA BRIDGE. WIDTH OF CHANNEL 500 FEET, SURFACE OF WATER 55 FEET ABOVE SEA LEVEL. OCTOBER, 1912.

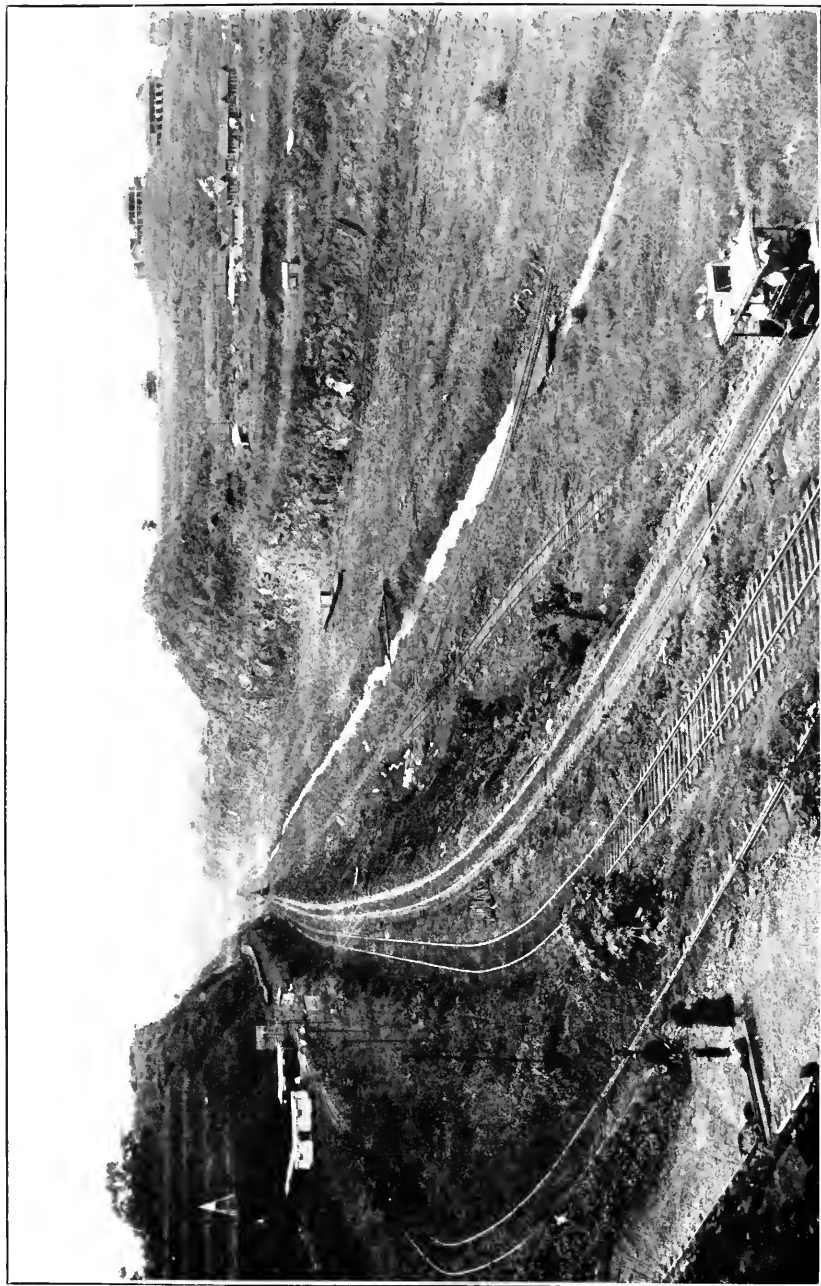






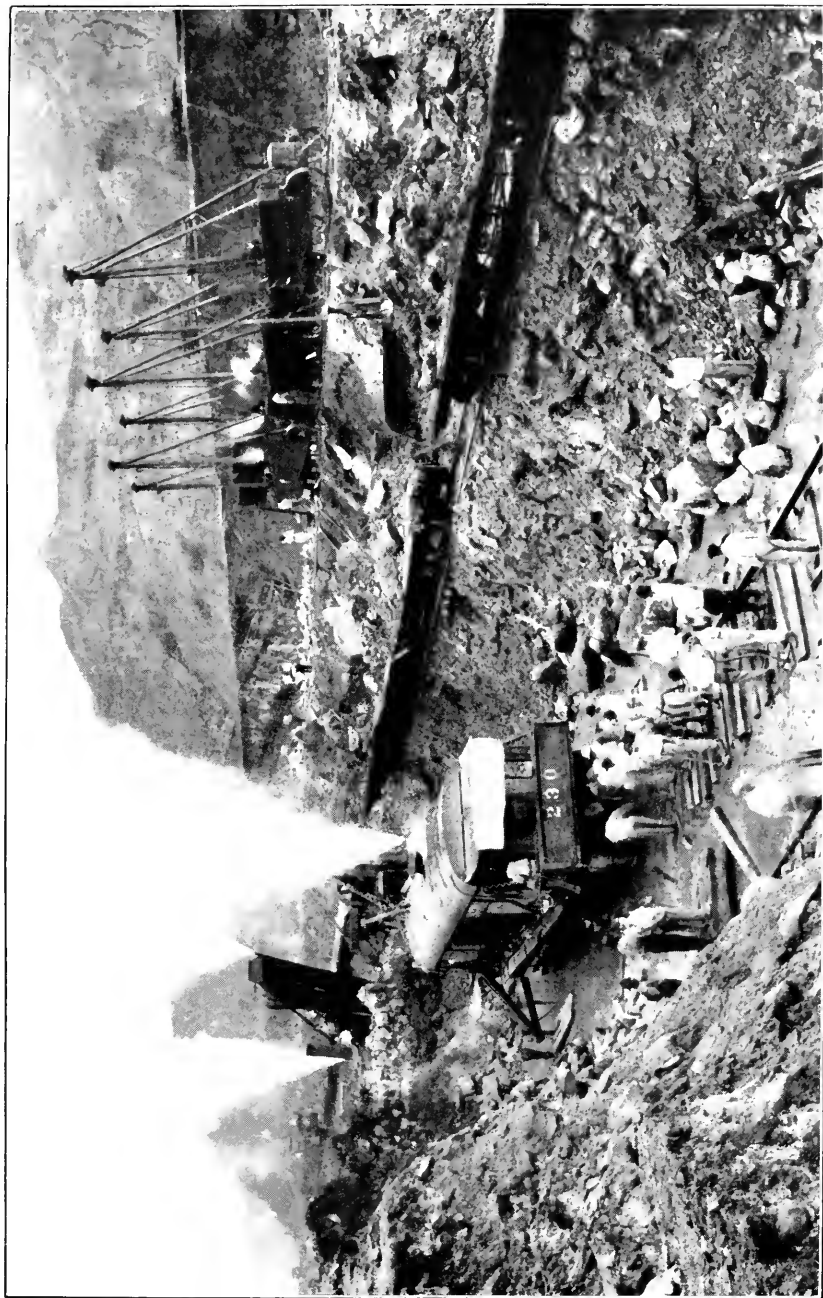
CULEBRA CUT, NORTH END, SHOWING DIKE ACROSS THE CANAL AT GAMBOA, AND THE CHAGRES RIVER, JUNE, 1913.





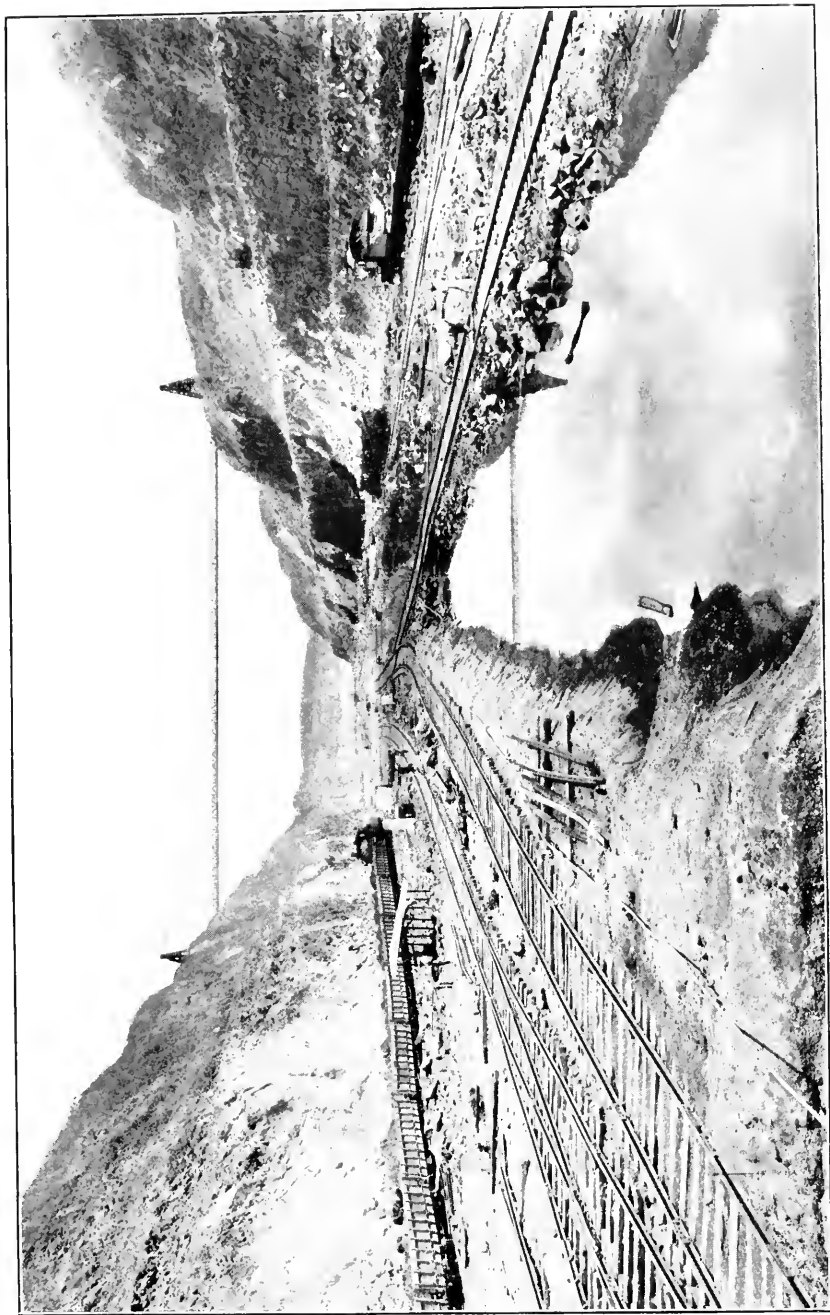
CULEBRA CUT, BAS OBISPO. LOOKING SOUTH FROM EAST BANK. JUNE, 1913.





CULEBRA CUT, CULEBRA. COMPLETION OF BOTTOM PIONEER CUT, STEAM SHOVELS NOS. 230 AND 222 MEETING AT GRADE.  
LOOKING NORTH FROM WEST BANK. MAY 20, 1913.

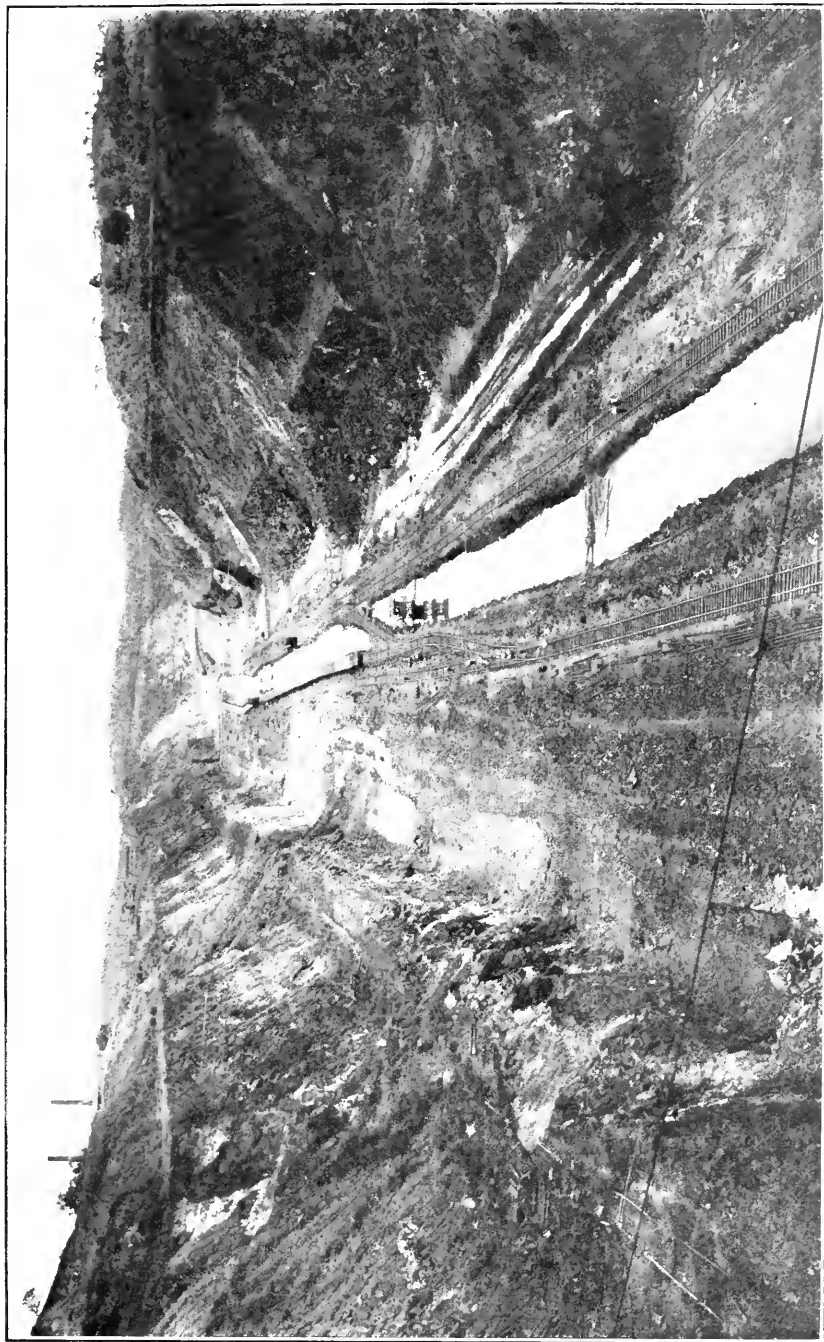




CULEBRA CUT. LOOKING NORTH FROM ONE-QUARTER MILE SOUTH OF SUSPENSION BRIDGE AT EMPIRE. CUT COMPLETED  
AT BRIDGE. ALL TRACKS ON COMPLETED BOTTOM OF CANAL. JUNE 16, 1913.







CULEBRA CUT, EMPIRE, LOOKING NORTH FROM SUSPENSION BRIDGE, SHOWING CUT COMPLETED, EXCEPT TOE OF SLIDE ON RIGHT. DRAINAGE DITCH IS BELOW BOTTOM OF CANAL. JUNE 16, 1913.





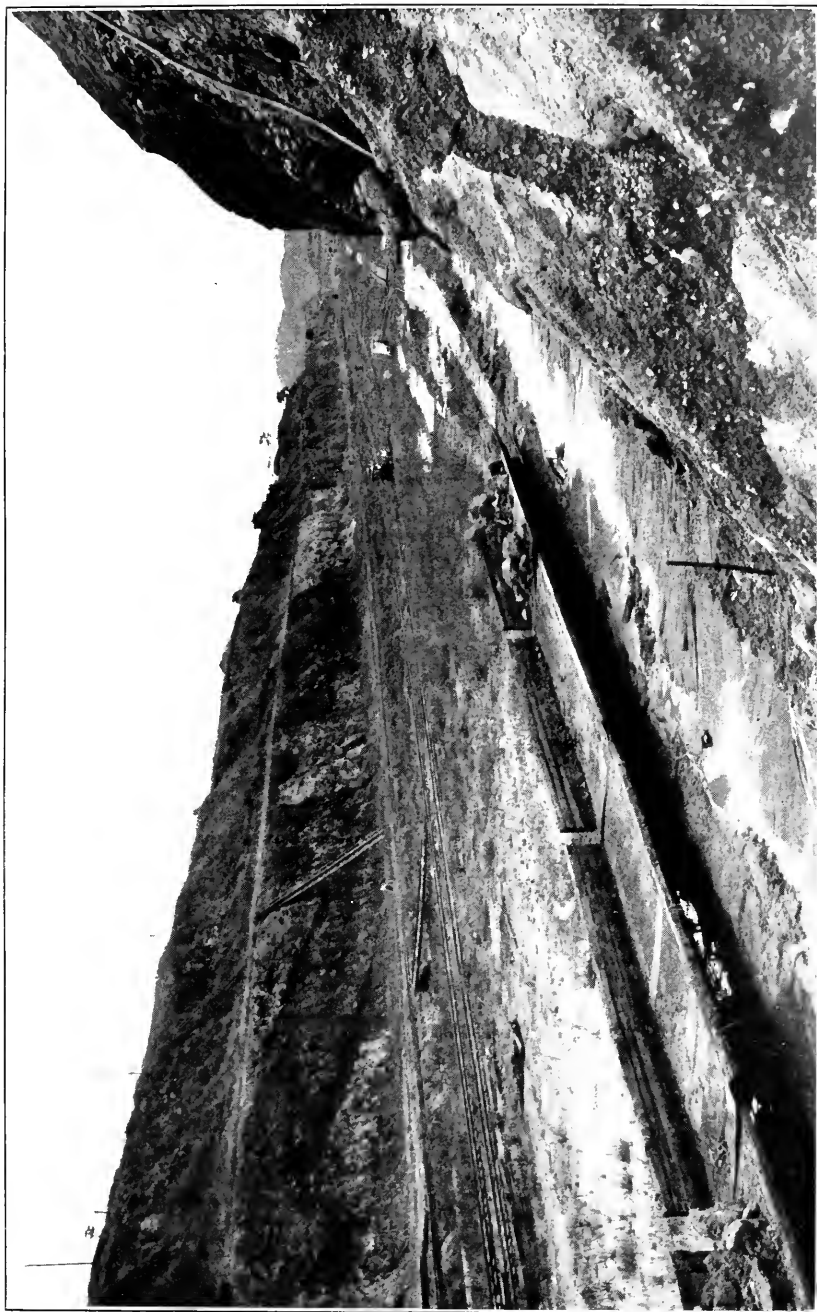
CULEBRA CUT, EMPIRE, LOOKING SOUTH FROM SUSPENSION BRIDGE, SHOWING TERRACING ON UPPER LEVELS OF EAST BANK TO PREVENT SLIDES. LOWER SHOVELS ARE WORKING ON BOTTOM OF CANAL. JUNE 16, 1913.





CULEBRA CUT, CULEBRA. DEEPEST EXCAVATED PORTION OF PANAMA CANAL, SHOWING GOLD HILL ON THE RIGHT AND CONTRACTORS HILL ON THE LEFT. JUNE, 1913.

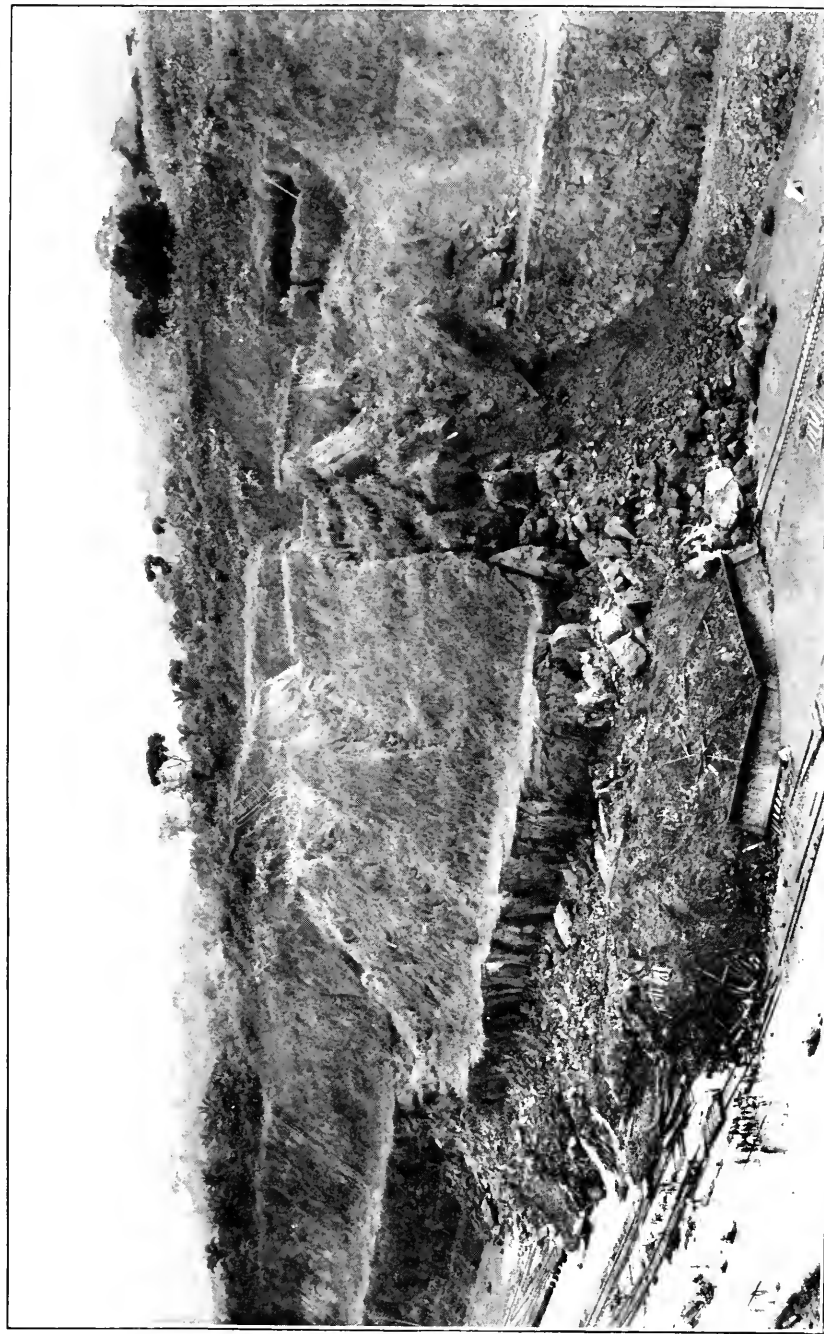




CULEBRA CUT, LAS CASCADAS. LOOKING NORTH FROM EAST BANK. JUNE, 1913.







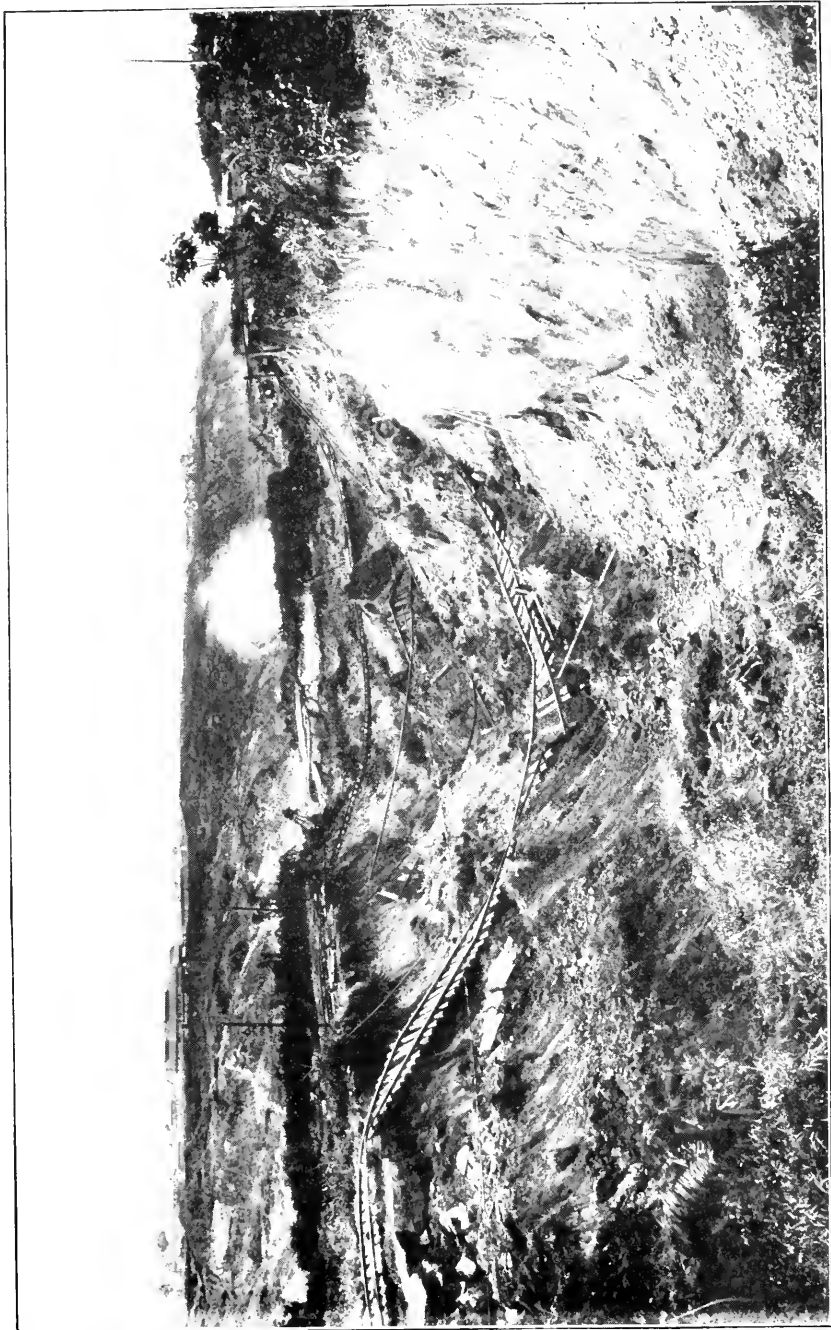
CULEBRA CUT, EMPIRE. BREAK IN EAST BANK AT LA PITA (STATION 1651), TAKING IN OBISPO DIVERSION CHANNEL, LOOKING NORTH, AUGUST 21, 1912.





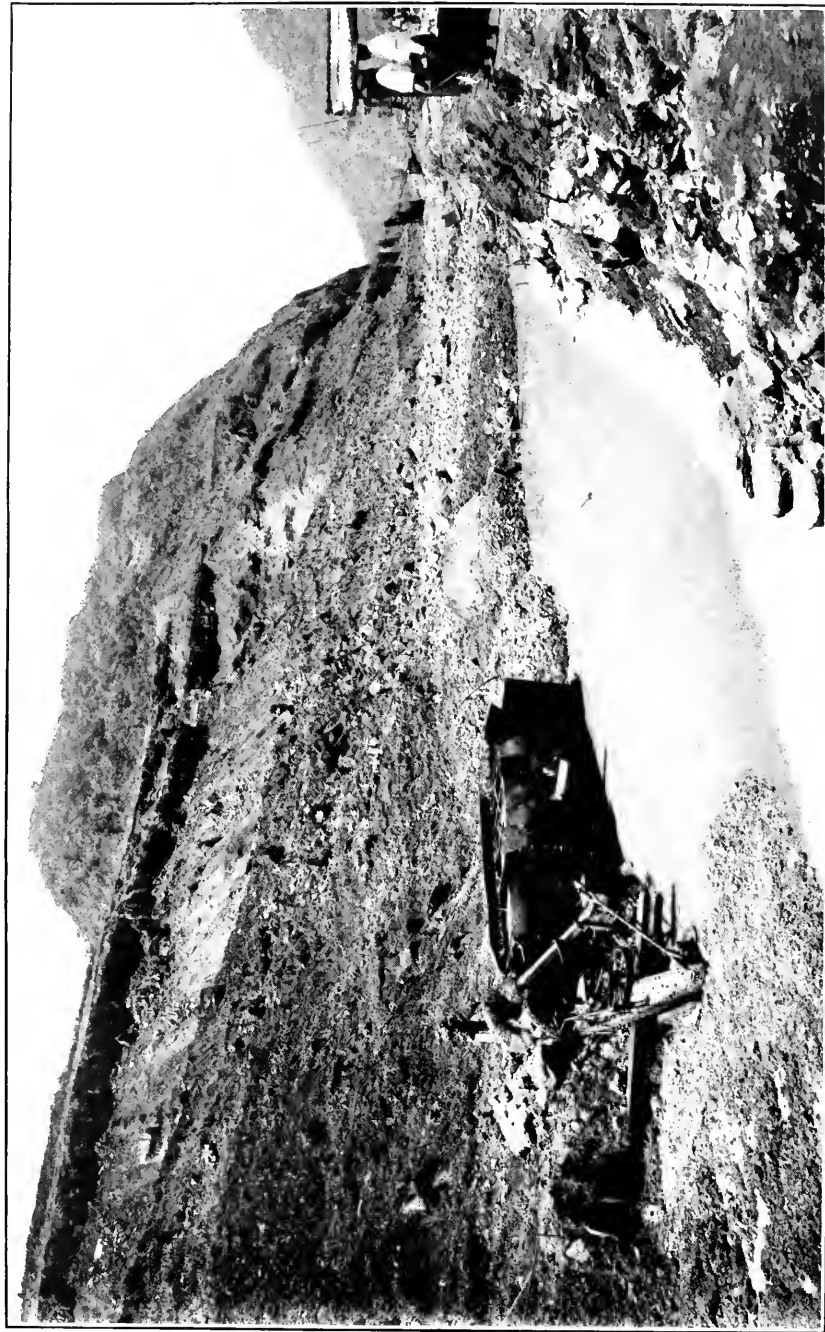
CULEBRA CUT, CULEBRA. BREAK IN EAST BANK BETWEEN STATIONS 1746-1758. STEAM SHOVEL NO. 201 IN MIDST OF UPHEAVED MATERIAL AND DISPLACED TRACKS, LOOKING SOUTH, FEBRUARY 6, 1913.





CULEBRA CUT, CULEBRA. BREAK IN EAST BANK BETWEEN STATIONS 1745-1758. TOP VIEW OF REAR PORTION OF SLIDE, LOOKING NORTH. FEBRUARY 6, 1913.

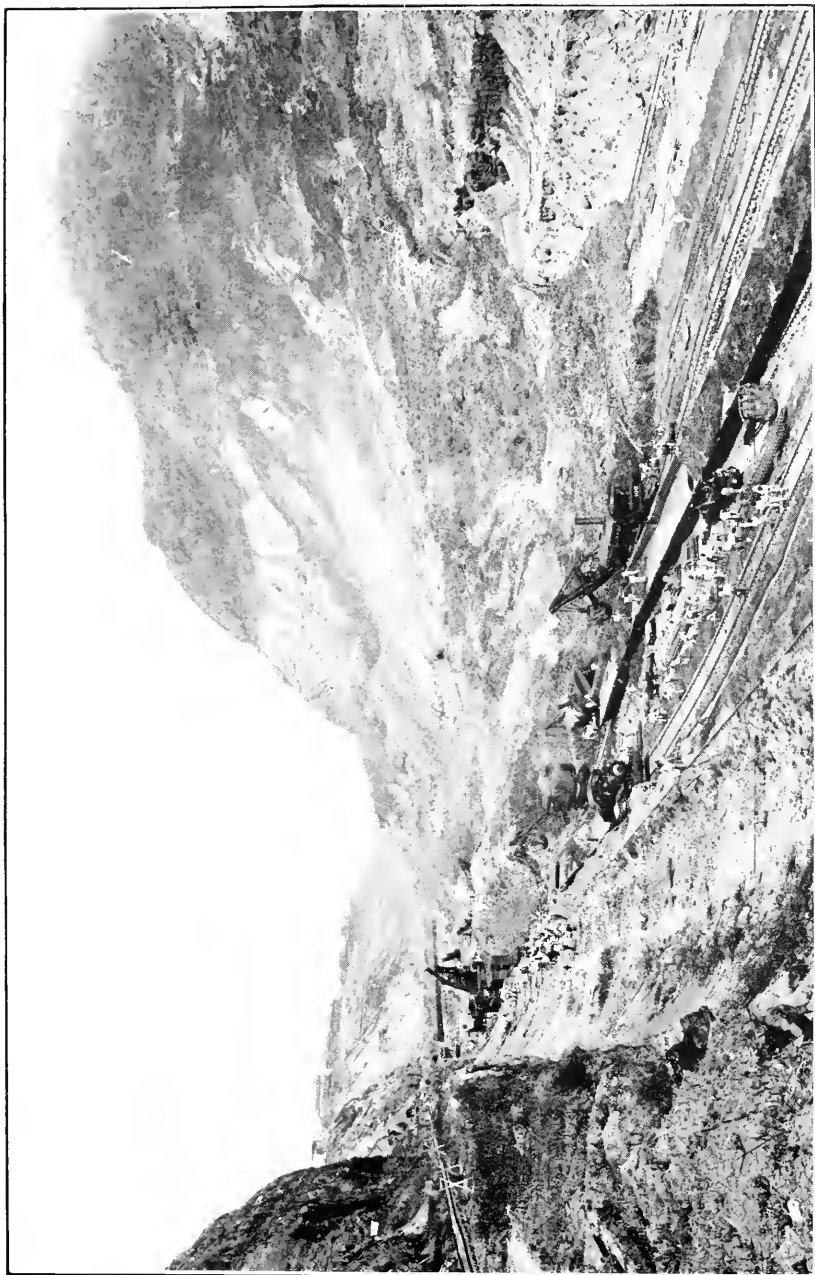




CULEBRA CUT, CULEBRA. BOTTOM OF CANAL, STEAM SHOVEL NO. 260 OVERTURNED BY SLIDE FROM EAST SLOPE. JUNE 12, 1913.

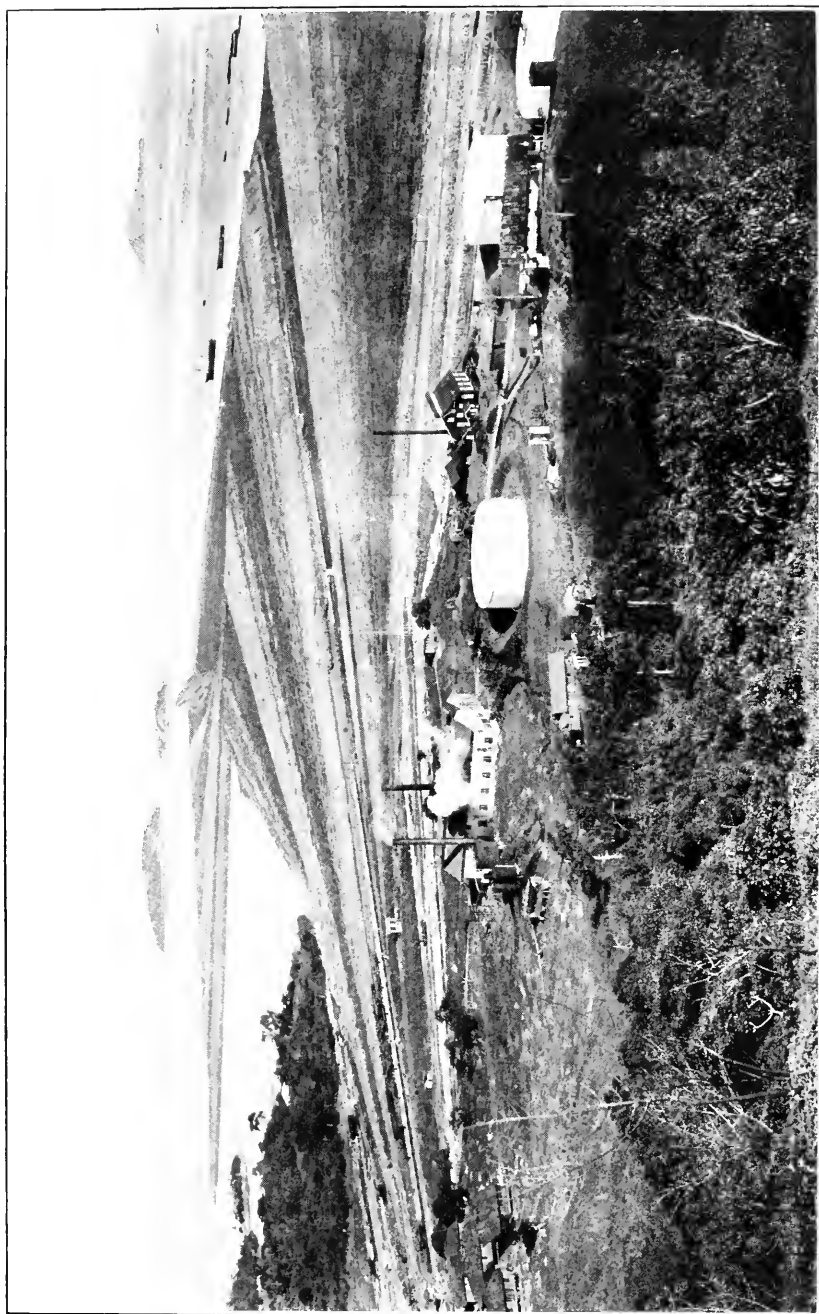






CULEBRA CUT, CULEBRA. LOOKING NORTH FROM WEST BANK, SOUTH OF CONTRACTORS HILL, SHOWING SHOVEL NO. 256  
CAUGHT IN CUCARACHA SLIDE. FEBRUARY 7, 1913.





DUMP IN PACIFIC OCEAN, AT BALBOA, MADE FROM MATERIAL TAKEN FROM CULEBRA CUT.



## APPENDIX D.

### REPORT OF H. O. COLE, RESIDENT ENGINEER, FIFTH DIVISION.

ISTHMIAN CANAL COMMISSION,  
DEPARTMENT OF CONSTRUCTION AND ENGINEERING,  
FIFTH DIVISION, CHIEF ENGINEER'S OFFICE,  
OFFICE OF THE RESIDENT ENGINEER,  
*Corozal, Canal Zone, July 31, 1913.*

SIR: I have the honor to submit the following report of operations in the fifth division of the chief engineer's office during the fiscal year ending June 30, 1913:

#### DIVISION ORGANIZATION.

Mr. S. B. Williamson, division engineer, and Mr. J. M. G. Watt, assistant division engineer, of the Pacific division, having resigned, the Pacific division was abolished and the fifth and sixth divisions created in accordance with your Circular No. 183-S, effective December 12, 1912, at which time the writer, who was formerly in direct charge of the construction of locks, dams, spillways, and transportation under the division engineer of the Pacific division, was appointed resident engineer in charge of the fifth division, including the construction of the Miraflores and Pedro Miguel Locks, dams, and spillway; dry excavation of the canal prism south of Pedro Miguel; municipal and sanitary work in that territory; hydraulic excavation; electrical department; Ancon quarry; transportation; and division office.

Outside of the above administrative changes the personnel of the forces has not changed materially, the organization and equipment varying from time to time as the progress and conditions in the work required. The electrical department was absorbed by the mechanical division, effective May 1, 1913.

A summary of the principal items of work performed in the above departments during the fiscal year is given in Table No. 1.

TABLE NO. 1.—*Principal items of work performed in the year ended June 30, 1913.*

Class of work.	Unit.	Quantity.
Dry excavation:		
Work.....	Cubic yards.....	3,415,471.00
Plant.....	do.....	738,963.00
Hydraulic excavation:		
Work.....	do.....	461,527.00
Plant.....	do.....	15,422.00
Explosives used.....	Gross tons.....	673.60
Rock drilling:		
By tripod drills.....	Linear feet.....	875,286.00
By well drills.....	do.....	234,877.00
By hand drills.....	do.....	400.00
Construction tracks laid.....	Miles.....	29.22
Trestle bents framed.....	Number.....	54.00
Piles driven.....	do.....	812.30
Dam filling, dry.....	Cubic yards.....	532,492.00
Back filling.....	do.....	1,495,919.00

TABLE NO. 1.—*Principal items of work performed in the year ended June 30, 1913*—Con.

Class of work.	Unit.	Quantity.
Concrete placed in locks:		
Work.....	Cubic yards.....	509,159.00
Plant.....	do.....	6,487.00
Concrete placed in dams, work.....	do.....	5,970.00
Concrete placed in spillway, work.....	do.....	64,142.00
Rock crushed.....	do.....	688,301.00
Return tracks laid.....	Linear feet.....	6,406.00
Coping drain covers.....	do.....	27,467.00
Lamp standards manufactured.....	Number.....	301.00
Vitrified ducts laid.....	Linear feet.....	394,451.00
Fiber ducts laid.....	do.....	7,723.00
Roads maintained.....	Miles.....	21.70
Drains and ditches dug.....	Cubic yards.....	5,079.00
Drains and ditches cleaned and graded.....	Linear feet.....	1,616,569.00
Water pipe laid.....	do.....	44,960.00
Sewer pipe laid.....	do.....	13,908.00
Clearing and grubbing.....	Acres.....	131.00
Daily average force employed:		7,489.00
Pacific division.....	Number.....	
Fifth division.....	do.....	5,946.00

## FIRST DISTRICT.

## LOCKS, DAMS, SPILLWAY DAM, AND DRY EXCAVATION.

[J. A. Walker, superintendent, lock construction.]

[R. B. Tinsley, assistant engineer.]

[J. A. McCulloch, superintendent on excavation.]

[J. H. Adams, supervisor on excavation.]

[W. J. Holmes, trainmaster.]

## PEDRO MIGUEL LOCKS AND DAMS.

The work consisted in excavating; preparing the lock foundations; fabricating and erecting forms; making and placing concrete for the lock, wing, and guide walls; the placing of fixed irons in masonry; the back filling of lock walls; the filling in of north and south guide walls and west dam—this work reaching the stage of practical completion during the fiscal year.

## LOCK EXCAVATION.

The excavation consisted principally of the excavation of French dump east of the lock site and excavation for the south guide wall extension, increasing the total for lock excavation to 1,102,165 cubic yards.

TABLE NO. 2.—*Lock and dam excavation, Pedro Miguel.*

Month.	Lock excavation.			Dam excavation.	
	Earth.	Rock.	Total.	East core wall.	West dam core.
1912.	<i>Cubic yards.</i>	<i>Cubic yards.</i>	<i>Cubic yards.</i>	<i>Cubic yards.</i>	<i>Cubic yards.</i>
July.....	3,044		3,044		274
September.....				956	
October.....				220	
November.....				45	
December.....				665	
1913.					
January.....				304	
Total this year.....	3,044		3,044	2,190	274
Previous to July 1, 1912.....			1,099,121		
Total to date.....			1,102,165		

## LOCK FOUNDATIONS.

The preparation of foundations for the guide and wing walls consisted of pick and shovel work of cleaning up after steam shovels had gotten all they could take, below the floor level.

TABLE NO. 3.—*Excavation for foundations, Pedro Miguel.*

Month.	Earth.	Rock.	Total.
	<i>Cu. yds.</i>	<i>Cu. yds.</i>	<i>Cu. yds.</i>
1912.			
July.....		1,094	1,094
August.....	1,216	3,650	4,866
September.....	64	593	657
October.....	520	517	1,037
November.....	1,407	945	2,352
December.....	250	1,867	2,117
1913.			
January.....	978	270	1,248
February.....		448	448
March.....		800	800
April.....	230	390	620
May.....		127	127
Total this year.....	4,665	10,701	15,366
Previous to July 1, 1912.....			179,757
Total to date.....			195,123

## CONSTRUCTION TRACKS.

All construction tracks were maintained, constructed, and relocated as required; 5.61 miles of new tracks were laid.

## PLACING CONCRETE.

The total amount of concrete placed in the Pedro Miguel Locks during the fiscal year was 58,262 cubic yards, mixed entirely by auxiliary mixers consisting of two 2-cubic yard mixers located in the south end of storage trestle in the forebay; also an average of 3.05 half-cubic yard mixers were used, and were moved about as the necessities required. The concrete was either handled by derricks and locomotive cranes or dumped into place direct by means of chutes. The total yardage is made up of 39,465 cubic yards of plain concrete and 18,797 cubic yards of reenforced concrete. The amount of concrete placed in the lock and dam at Pedro Miguel is shown in Table No. 4, and the performance of the auxiliary concrete plant is given in Table No. 5.

The total amount of concrete placed prior to June 30, 1913, in the Pedro Miguel Locks is 906,187 cubic yards, shown progressively on plate No. 97.

TABLE NO. 4.—Concrete placed, lock and dam, Pedro Miguel.

Month.	Lock.		Dam (plain).	Total.	
	Plain.	Reenforced.		Plain.	Work.
1912.					
July.....	<i>Cubic yards.</i> 6,142	<i>Cubic yards.</i> 5,340	<i>Cubic yards.</i> 479	<i>Cubic yards.</i> .....	<i>Cubic yards.</i> 11,961
August.....	3,911	2,103	418	.....	6,432
September.....	2,384	669	.....	.....	3,053
October.....	6,362	240	40	.....	6,642
November.....	7,541	124	.....	316	7,665
December.....	5,508	274	.....	1,179	5,782
1913.					
January.....	4,950	1,210	630	46	6,790
February.....	2,362	1,935	.....	.....	4,297
March.....	123	4,678	.....	57	4,801
April.....	62	1,597	.....	.....	1,659
May.....	106	488	.....	545	594
June.....	14	244	.....	55	258
Total this year.....	39,465	18,902	1,567	2,148	59,934
Previous to July 1, 1912.....	.....	.....	.....	.....	847,926
Total to date.....	.....	.....	.....	.....	907,860

TABLE NO. 5.—Performance of auxiliary concrete plant, Pedro Miguel, 1912-13.

Month.	Mixers used.		Working days.	Working time (mixer hours).		Concrete placed (cubic yards).		
	Average number.	Size (cubic yards).		Total.	Per day.	Total.	Per day.	Per mixer hour.
1912.								
July.....	1.00	2	26	114.50	4.40	4,486	172.54	39.2
	4.85	$\frac{1}{2}$	26	709.25	27.27	7,368	283.38	10.4
August.....	1.00	2	17	65.00	3.82	1,373	80.76	21.1
	3.81	$\frac{1}{2}$	27	700.50	25.92	4,910	181.85	7.0
September.....		2						
	2.71	$\frac{1}{2}$	24	339.50	14.15	2,932	122.16	8.6
October.....	2.93	$\frac{1}{2}$	28	593.25	21.18	5,609	200.32	9.5
November.....	4.38	$\frac{1}{2}$	24	777.75	32.41	7,819	325.79	10.0
December.....		2						
	4.68	$\frac{1}{2}$	25	815.50	32.61	7,485	299.40	9.1
1913.								
January.....	4.19	$\frac{1}{2}$	26	731.50	28.13	7,083	272.42	9.7
February.....	3.19	$\frac{1}{2}$	21	450.00	21.40	4,468	212.76	9.9
March.....	2.08	$\frac{1}{2}$	25	428.00	17.12	5,063	202.52	11.8
April.....	1.26	$\frac{1}{2}$	19	162.00	8.53	1,627	85.63	10.0
May.....	1.27	$\frac{1}{2}$	22	127.00	5.77	1,001	45.50	7.9
June.....	1.20	$\frac{1}{2}$	5	37.75	7.55	225	45.00	6.0
Totals:								
2-yard mixers.....	1.00	2	43	179.50	4.17	5,859	136.25	32.7
One-half yard mixers.....	3.05	$\frac{1}{2}$	272	5,872.00	21.59	55,590	204.37	9.5

NOTE.—Quantities in above table are "bucket measurements;" 1,567 cubic yards of concrete mixed at this plant were placed in Pedro Miguel dams.



## MISCELLANEOUS LOCK WORK.

Miscellaneous work done in connection with Pedro Miguel Locks is compiled in Table No. 6.

TABLE NO. 6.—*Miscellaneous lock work at Pedro Miguel.*

Month.	Trestle bents framed (number).	Fiber ducts laid (linear feet).	Vitri-fied ducts laid (linear feet).	Piles driven (num-ber).	Water gauges set (linear feet).	Return track laid (linear feet).	Coping drain covers (linear feet).	Steel placed.	
								Reenforc-ing bars (pounds).	Fixed lock iron (pounds).
1912.									
July.....			3,594			352	216	285,477	150,014
August.....			16,278		97	461	3,105	16,939	84,296
September.....	6		28,808			130	2,833	636	
October.....		1,056	24,224				3,005	1,163	
November.....	13	525	14,170				2,021	9,188	
December.....		1,058	5,469				241	168,994	36,342
1913.									
January.....		126	9,845				296	182,412	
February.....		658	9,845				95	151,923	
March.....		210	17,903		73			171,155	
April.....			7,853	16				158,278	392,838
May.....			876					6,670	128,751
June.....									
Totals.....	19	3,633	138,865	16	170	943	11,812	1,152,895	792,241

## BACK FILLING.

The back filling of the lock and wing walls was carried to completion and the hard rock riprap finish for ends of wing walls was partly placed at the close of the fiscal year, as shown in Table No. 7.

TABLE NO. 7.—*Back filling lock walls, Pedro Miguel.*

Month.	East wall.	Center wall.	West wall.	Total.
1912.				
	<i>Cubic yds.</i>	<i>Cubic yds.</i>	<i>Cubic yds.</i>	<i>Cubic yds.</i>
July.....	9,704	3,404	480	13,588
August.....	12,741	9,890	2,670	25,301
September.....	8,096	597	9,200	17,893
October.....	13,059	16,897		29,956
November.....	4,659	14,597		19,256
December.....	10,996	3,420		14,416
1913.				
January.....	11,023	15,448		26,471
February.....	13,335	26,416	13,067	52,818
March.....	19,400	32,000		51,400
April.....	20,984	39,318	4,768	65,070
May.....	12,496	19,950		32,446
June.....	6,780	11,275	480	18,535
Total this year.....	143,273	193,212	30,665	367,150
Previous to July 1, 1912.....				654,537
Total to date.....				1,021,687

## FILLING WEST DAM.

The west dam at Pedro Miguel, consisting of rock-filled sides and puddled clay core, was completed and the top finished at elevation plus 107 with clay. The north face was ripped with hard rock at the 85-foot level; 114,117 cubic yards of fill were added during the year, making a total fill of 696,558 cubic yards in the dam.

TABLE NO. 8.—*Filling of west dam, Pedro Miguel.*

Month.	Dam fill.	Month.	Dam fill.
	<i>Cubic yards.</i>		<i>Cubic yards.</i>
1912.		1913.	
July.....	16, 150	January.....	20, 198
August.....	12, 481	March.....	2, 000
September.....	13, 615	May.....	100
October.....	16, 267	June.....	13, 580
November.....	18, 030		
December.....	11, 696	Total this year.....	114, 117
		Previous to July 1, 1912.....	582, 441
		Total to date.....	696, 558

<sup>1</sup> The 3,580 cubic yards placed during the month of June, 1913, consisted of hard rock riprap.

#### MIRAFLORES LOCKS, DAM AND SPILLWAY.

The lock excavation, preparing foundations, and placing concrete for the Miraflores Locks proper were carried to completion during the fiscal year. The construction of west dam was completed except a small portion at the junction with the core wall and back fill of the lock walls at the point where the west side main-line tracks pass over.

The east dam and spillway excavation was completed and about 90 per cent of the concrete placed at the end of the fiscal year.

#### CONSTRUCTION TRACKS.

In addition to maintaining and moving tracks as required, 23.61 miles of new construction tracks were built in connection with the work at Miraflores.

#### LOCK FOUNDATIONS.

The lock foundation work for the lower west wall was rendered very difficult owing to slides and water-bearing strata of banks. It became necessary in places to build retaining walls to prevent mud and water from flowing in onto the foundation areas, the slides in the banks often reaching back to and carrying the berm crane tracks away, thus necessitating the use of auxiliary concrete mixers for laying concrete in wall bases to an elevation that would permit back filling to support berm crane tracks. The total amount of excavation taken out for the main lock foundations during the fiscal year was 49,048 cubic yards.

The north guide wall is supported entirely on concrete caissons sunk to bedrock. These caissons consisted of reinforced concrete shells, 7½ feet in diameter and 1 foot thick, built up in sections 6 feet long and sunk progressively, the bottom shell having a steel shoe for cutting edge. The interior excavation was loaded into buckets of about 5 cubic feet capacity by hand and hoisted by handling plants consisting of eight units operated by one engine, the units being joined by continuous sprocket chain.

The caissons were sunk to bedrock and filled with concrete, forming solid columns, and were spaced 15-foot centers longitudinally and 27-foot centers transversely. The cellular guide wall was then supported on heavily reinforced concrete girders spanning the caissons in both directions. The progress in sinking foundation caissons for the north guide wall is shown on plate No. 98.

TABLE NO 9.—*Excavation for foundations, Miraflores Locks.*

Month.	Dam core (earth).	Lock excavation.		
		Earth.	Rock.	Total.
1912.	<i>Cubic yards.</i>	<i>Cubic yards.</i>	<i>Cubic yards.</i>	<i>Cubic yards.</i>
July.....	.....	356	5,086	5,442
August.....	.....	166	6,044	6,210
September.....	1,333	455	3,404	3,859
October.....	.....	520	3,944	4,464
November.....	530	2,274	3,320	5,594
December.....	.....	22	9,980	10,002
1913.	.....	.....	.....	.....
January.....	.....	.....	7,632	7,632
February.....	.....	.....	2,355	2,355
March.....	.....	.....	3,100	3,100
April.....	8,060	.....	390	390
Total.....	9,923	3,793	45,255	49,048

## CONCRETE-HANDLING PLANT.

The construction plant consists of four berm and four chamber cranes, as described in previous annual reports. Two berm cranes are located on the west side and two on the east side, which were used in the construction of the side walls. The chamber cranes were used in the concrete construction of the middle and south guide walls, and also for back filling the same with earth and rock. The concrete was delivered to these chamber cranes by the narrow-gauge equipment, supplied principally by two 2-yard mixers located in the side wall and partly by the berm cranes delivering concrete to the buckets on the transfer cars by means of hoppers and chutes. The back filling was supplied on both narrow-gauge and standard-gauge cars, in 2 cubic yard skips, which were loaded direct by steam shovels excavating in the canal prism. The concrete-handling cranes were also used in handling forms and irons which were placed in the masonry. After the lock gate construction in the lower east chamber started one chamber crane was confined to the upper east chamber, one to the lower east chamber, and two along the east side of the south guide wall.

The concrete in the locks proper was completed on May 17, except reenforced concrete floor and stairway in the middle wall at the junction of the upper and lower locks, which was completed on June 10. On account of the slides, the concrete in the southwest wall was finished last, the east berm cranes completing their work of constructing the east wall some two or three months prior, but were continued in use by supplying concrete to the chamber cranes for the construction of a portion of the south guide wall, and, as will be noted, were subsequently used for supplying concrete in the construction of the spillway dam.

## PLACING CONCRETE.

The total amount of concrete placed in the Miraflores Locks during the past fiscal year is 450,655 cubic yards, made up of 402,607 cubic yards of plain and 48,048 cubic yards of reenforced concrete. The total amount of concrete placed in the Miraflores Locks to July 1, 1913, is 1,476,758 cubic yards. The progress of concrete construction work is shown graphically on plate No. 99, and the performance records of the permanent and auxiliary concrete construction plants are given in the following tables:

TABLE No. 10.—*Performance of berm cranes at Miraflores, 1912-13.*

Date.	Number of cranes.	Number of mixers (2 cubic yards).	Concrete mixed.	Service time of cranes.					Rate per hour per crane.		Working hours to total hours (efficiency).		
				Working hours.		Hours delay.			Total hours.	Mixing and placing.		Total.	
				Mixing and placing.	Handling forms, steel, etc.	Repairs to cranes.	Repairs to mixers.	Waiting for forms.					Other delays.
1912.				<i>Cu. yds.</i>					<i>Cu. yds.</i>	<i>Cu. yds.</i>			
July.....	3.84	6.65	23,518	503.60	56.58	25.17	0.67	194.50	153.48	934.00	0.6104		
August.....	4.00	6.96	27,734	485.76	34.66	15.60	2.58	271.34	269.56	1,079.50	.4500		
September.....	3.71	6.17	16,908	335.16	24.18	14.16	1.38	288.45	138.67	801.00	.4480		
October.....	3.93	6.67	28,730	384.36	33.84	4.50	1.84	315.56	273.90	1,014.00	.4145		
November.....	3.83	7.02	33,556	375.76	26.74	18.42	3.16	91.84	378.58	894.50	.4629		
December.....	3.96	7.89	41,262	497.41	8.33	45.08	6.92	119.83	273.43	951.00	.5318		
1913.													
January.....	4.00	8.00	44,048	524.16	12.00	51.93	10.91	86.41	250.59	936.00	.5728		
February.....	3.83	7.74	32,072	404.58	14.25	13.50	4.16	137.35	218.16	792.00	.5288		
March.....	3.72	7.44	23,878	353.25	5.00	10.42	4.08	189.83	195.42	738.00	.4724		
April.....	4.00	8.00	14,306	188.74	30.25	.42	2.90	127.09	121.60	471.00	.4649		
May.....	1.65	3.30	12,623	170.91	1.00	4.16	1.00	105.42	113.51	396.00	.4341		
June.....	1.04	2.00	10,279	139.16	6.00	2.00	.25	.....	101.09	248.50	.5600		
Totals:													
Cranes.....	3.40	.....	308,914	4,362.85	252.83	205.36	38.85	1,927.62	2,487.99	9,275.50	.4703		
Mixers.....	.....	6.42	308,914	8,152.05	.....	.....	.....	.....	9,108.33	17,260.38	.4723		

<sup>1</sup> In figuring the efficiency for mixers, the "mixing and placing" time only is considered the working hours. Quantities in this table are "bucket measurement."

TABLE NO. 11.—Performance of chamber cranes at Miraflores, 1912-13

Month.	Number of cranes.	Material placed.			Service time.					Rate per hour per crane.		Working time to time in service.		
		Concrete.	Fill.	Total.	Hours working.		Hours delay.			Total hours per month.	Placing time.		Total. time.	
					Placing concrete and fill.	Handling forms, steel, etc.	Repairs to cranes.	Waiting for concrete or fill.	Waiting for forms.					Other delays.
1912.														
July.....	3.48	Cu. yds. 30,705	Cu. yds. 6,211	Cu. yds. 36,916	689.46	97.73	24.11	265.95	43.74	135.51	1,256.50	Cu. yds. 53.6	29.4	0.6225
August.....	4.00	42,462	.....	42,462	806.77	133.23	8.13	222.71	39.75	95.41	1,306.00	52.6	32.5	.7197
September.....	3.79	22,798	720	23,518	500.33	46.00	10.52	180.75	15.58	65.52	819.00	46.1	28.8	.6605
October.....	3.96	24,889	.....	24,889	500.91	90.78	11.23	368.67	45.57	100.34	1,117.50	50.5	22.4	.5280
November.....	3.66	18,767	889	19,656	429.92	94.17	29.69	208.32	18.58	102.82	883.50	45.7	22.2	.5932
December.....	3.96	24,982	312	25,294	515.07	94.23	12.83	159.68	98.84	82.35	963.00	49.1	26.3	.6327
1913.														
January.....	4.00	24,330	.....	24,330	447.09	63.42	11.00	155.33	176.50	82.66	936.00	54.4	26.0	.5240
February.....	3.47	16,897	240	17,137	338.08	91.09	2.03	110.00	168.00	64.80	774.00	50.7	22.1	.5545
March.....	3.28	9,053	6,929	15,982	355.00	61.58	1.67	141.18	147.65	60.92	768.00	45.0	20.8	.5424
April.....	4.00	2,020	24,652	26,672	462.56	96.33	8.67	390.62	69.92	63.90	1,092.00	62.5	24.8	.4788
May.....	3.96	436	22,632	23,068	428.67	4.18	1.33	609.74	1.00	38.08	1,083.00	53.8	21.3	.3997
June.....	3.56	796	29,774	30,570	551.16	3.50	3.33	340.17	10.00	30.84	939.00	55.5	32.6	.5942
Total.....	3.74	218,135	92,359	310,494	6,025.02	876.24	124.84	3,153.12	835.13	923.15	11,937.50	51.5	26.0	.5789

NOTE.—Quantities in this table are "bucket measurements."

TABLE NO. 12.—*Performance of auxiliary concrete plant at Miraflores, 1912-13.*

Month.	Mixers used.		Working days.	Working time (mixer hours).		Concrete placed.		
	Average number.	Size (cubic yards).		Total.	Per day.	Total.	Per day.	Per mixer hour.
1912.						<i>Cu. yds.</i>	<i>Cu. yds.</i>	<i>Cu. yds.</i>
July.....	2.48	2	27	467.96	17.33	31,443	1,164.55	67.2
	6.15	$\frac{1}{2}$	26	1,096.60	42.18	10,620	408.46	9.6
August.....	2.00	2	27	483.54	17.91	34,784	1,251.26	69.9
	6.04	$\frac{1}{2}$	27	1,132.50	41.94	11,551	427.81	10.2
September.....	1.68	2	22	289.60	13.16	19,128	869.45	66.0
	1.59	1	17	143.50	8.44	2,221	130.65	12.5
	4.91	$\frac{1}{2}$	24	896.00	37.33	7,996	333.17	8.9
October.....	1.57	2	21	197.23	9.39	12,248	583.24	62.1
	1.81	1	26	295.00	11.34	5,413	208.19	18.4
	5.04	$\frac{1}{2}$	27	997.00	36.93	9,253	342.70	9.3
November.....	1.61	13	13	123.50	9.27	2,100	161.54	17.4
	3.29	$\frac{1}{2}$	24	520.50	21.70	4,550	189.58	8.7
December.....	1.75	1	16	177.00	11.06	1,953	122.06	11.0
	2.80	$\frac{1}{2}$	25	472.50	18.90	3,822	152.88	8.1
1913.								
January.....	1.00	1	22	147.50	6.70	1,731	78.68	11.7
	2.58	$\frac{1}{2}$	26	567.00	21.81	4,723	181.65	8.4
February.....	1.00	1	3	16.00	5.33	157	52.33	9.8
	1.70	$\frac{1}{2}$	23	281.00	12.22	2,458	106.87	8.7
March.....		1						
	1.69	$\frac{1}{2}$	26	322.00	12.38	2,630	101.15	8.1
April.....		1						
	1.29	$\frac{1}{2}$	21	162.75	7.75	1,257	59.86	7.7
May.....		1						
	1.00	$\frac{1}{2}$	19	134.00	7.05	803	42.26	6.0
June.....		1						
	1.00	$\frac{1}{2}$	11	64.00	5.82	479	43.55	7.5
Totals:								
2-yard mixers.....	1.93	2	97	1,438.33	14.83	97,603	1,006.22	67.8
1-yard mixers.....	1.46	1	97	902.50	9.30	13,575	139.95	15.0
One-half-yard mixers.....	3.12	$\frac{1}{2}$	279	6,645.85	23.82	60,142	215.56	9.0

NOTE.—Quantities in above table are "bucket measurements."

The complete records of the performances of the permanent concrete plant, at both Pedro Miguel and Miraflores, are shown diagrammatically on plates Nos. 100 and 101.

TABLE NO. 13.—*Concrete placed in locks and west dam at Miraflores.*

Month.	Lock concrete.		Plant.		West Dam (plain).	Total.
	Plain.	Reenforced.	Plain.	Reenforced.		
1912.	<i>Cubic yards.</i>	<i>Cubic yards.</i>	<i>Cubic yards.</i>	<i>Cubic yards.</i>	<i>Cubic yards.</i>	<i>Cubic yards.</i>
July.....	60,857	5,171	78		150	66,256
August.....	68,184	7,229	60			75,473
September.....	41,178	4,962	58			46,198
October.....	49,003	5,807	97			54,907
November.....	31,784	5,102	60			39,946
December.....	42,763	4,986			440	48,189
1913.						
January.....	45,501	4,973	50	60	2,628	53,212
February.....	31,692	3,292		123	755	35,862
March.....	15,742	3,530	862		430	20,564
April.....	9,350	1,930	960	49		12,289
May.....	3,447	612	652	235		4,946
June.....	106	591	747	248		1,692
Total this year.....	402,607	48,185	3,624	715	4,403	459,534
Previous to July 1, 1912.....	1,003,659	22,444				
Total to date.....	1,406,266	70,629				

## CONCRETE FORMS.

The wooden forms used in the concrete construction are similar to those described and illustrated in previous annual reports.

## MISCELLANEOUS LOCK WORK.

Miscellaneous work performed in connection with the Miraflores locks is compiled in Table No. 14.

TABLE NO. 14.—*Miscellaneous lock work at Miraflores.*

Month.	Trestle bents framed (number).	Fiber ducts laid (linear feet).	Vitri-fied ducts laid (linear feet).	Piles driven (num-ber).	Piling founda-tions (linear feet).	Return tracks laid (linear feet).	Coping drain covers (linear feet).	Steel placed.	
								Reenforc-ing bars (pounds).	Fixed lock iron (pounds).
1912.									
July.....			19,910		525	480	284	595,018	452,494
August.....			27,140		5,740	330	4,115	477,584	825,613
September.....			14,020		5,040	420	3,755	354,175	1,436,729
October.....			18,336		1,295	370	3,983	309,453	582,145
November.....			13,500		12,145	172	2,679	356,995	436,735
December.....			36,852	20		870	320	256,168	529,148
1913.									
January.....	4		10,542	206	2,605	900	493	99,343	981,702
February.....	3	450	10,542	131	3,950	835	26	77,770	203,380
March.....	6	260	32,976	264	6,825	766		69,919	215,263
April.....	5	1,780	48,456	115		230		52,636	550,175
May.....	11	584	17,056	60		90		74,377	386,880
June.....	6	1,016	6,256					9,179	209,818
Total.....	35	4,090	255,586	796	38,125	5,463	15,655	2,732,617	6,810,182

## WEST DAM.

The method of constructing the west dam at Miraflores with hydraulic core filling is described in previous annual reports.

The dry filling and finishing work of this dam has continued throughout the year, and at the close of the fiscal year was completed with the exception of a small part of the junction to the back filling of the west wall, at which point it is left low on account of the crossing of the west side main-line tracks.

During the year a complete covering has been made to the hydraulic clay core. Much difficulty was experienced in making this dry fill over the core on account of the hydraulic fill being soft and deep, permitting the dry fill to arch, until sufficient weight was added; then the fill would shear off almost vertically and subside, carrying tracks with it, necessitating great care while dumping, lest trains be carried down also.

As shown in Table No. 15, 418,375 cubic yards were added during the past fiscal year.

TABLE NO. 15.—*Filling of west dam, Miraflores (dry fill).*

Month.	Fill.	Month.	Fill.
1912.	<i>Cubic yards.</i>	1913—Continued.	<i>Cubic yards.</i>
July.....	37,820	March.....	43,800
August.....	45,140	April.....	16,215
September.....	17,970	May.....	12,570
October.....	57,265	June.....	11,800
November.....	46,115	Total this year.....	418,375
December.....	42,485	Previous to July 1, 1912.....	1,241,624
1913.		Total to date.....	1,659,999
January.....	52,195		
February.....	35,000		

## BACK FILLING.

Back filling the lock walls has been continued throughout the year with material from the prism excavation, and was approximately 98 per cent completed at the close of the fiscal year. The amount of back filling placed during the year is shown in the following table:

TABLE NO. 16.—*Back filling lock walls, Miraflores.*

Month.	East wall.	Center wall.	West wall.	Total.
1912.	<i>Cubic yards.</i>	<i>Cubic yards.</i>	<i>Cubic yards.</i>	<i>Cubic yards.</i>
July.....	54,680	6,211	18,396	79,287
August.....	63,874	.....	14,815	78,689
September.....	30,410	1,996	13,974	46,380
October.....	29,770	925	40,415	71,110
November.....	17,704	1,414	49,793	68,911
December.....	35,289	1,554	59,796	96,639
1913.				
January.....	12,800	352	99,142	112,294
February.....	10,059	314	67,578	77,951
March.....	1,700	8,800	88,500	99,000
April.....	4,680	26,856	85,118	116,654
May.....	3,930	24,214	62,260	90,404
June.....	.....	76,665	114,785	191,450
Total this year.....	264,896	149,301	714,572	1,128,769
Previous to July 1, 1912.....	.....	.....	.....	1,034,498
Total to date.....	.....	.....	.....	2,163,267

## SPILLWAY DAM, MIRAFLORES.

During September and October, 1912, 9,896 cubic yards of excavation were made for the spillway dam by the hydraulic method. Owing to the limited space in the vicinity of rivers and railroad tracks this method was abandoned and the excavation was continued by the use of steam shovels, also by hand excavation loading skips, which were handled by derricks and locomotive cranes. The central division tracks passing through the spillway site, and over which Lidgerwood trains operated from the Culebra Cut, were removed on March 1, thus permitting full access for excavating the foundations of the dam from east to west.

More or less difficulty was experienced owing to the fact of the Rio Grande passing through the site of the dam, which had to be diverted from time to time as the excavation work progressed. The concrete in the west end of the dam was finally brought up to the elevation of the bottom of the river and an opening left in the concrete through



which to divert the river. The river was diked off and confined to this space, which eliminated further particular trouble from this source.

The amount of excavation required for the spillway dam is shown in the following table:

TABLE NO. 17.—*Excavation for Miraflores spillway dam.*

Month.	Steam shovel.		Hand.		Hydraulic.	Total.
	Earth.	Rock.	Earth.	Rock.		
1912.	<i>Cubic yards.</i>	<i>Cubic yards.</i>	<i>Cubic yards.</i>	<i>Cubic yards.</i>	<i>Cubic yards.</i>	<i>Cubic yards.</i>
September.....					3,000	3,000
October.....		9,333		310	6,896	16,539
November.....		20,814	790			21,604
December.....	1,555	13,993		4,769		20,317
1913.						
January.....	1,567	12,476		4,808		18,851
February.....				10,177		10,177
March.....		22,300		3,300		25,600
April.....		11,158		3,647		14,805
May.....				3,778		3,778
Total.....	3,122	90,074	790	30,789	9,896	134,671

## CONCRETE WORK, MIRAFLORES SPILLWAY.

In order to facilitate the construction of both the excavation and concrete work, a trestle was driven along the north face of the spillway dam with a spur track leading off and connecting with the main-line tracks north of the spillway. From this trestle locomotive cranes were operated in handling concrete and materials to the wall. Narrow-gauge tracks were built from the berm cranes located on the east side of the locks to the south toe of the dam, ending in various spurs leading to derricks which handled the concrete, mixed by the berm cranes and delivered on transfer cars in 2-cubic-yard buckets—similar to the delivery to chamber cranes. The concrete work in the dam was approximately 90 per cent completed at the close of the fiscal year.

The amount of concrete placed in the spillway dam is shown in the following table:

TABLE NO. 18.—*Concrete placed in Miraflores spillway dam.*

Month.	Plain.	Reinforced.	Total.
1913.	<i>Cubic yards.</i>	<i>Cubic yards.</i>	<i>Cubic yards.</i>
January.....	1,077		1,077
February.....	3,653		3,653
March.....	12,432		12,432
April.....	6,222	62	6,284
May.....	18,607	130	18,737
June.....	21,716	243	21,959
Total.....	63,707	435	64,142

TABLE NO. 19.—*Performance of auxiliary concrete plant, Miraflores Spillway Dam.*

Month.	Mixers used.		Work- ing days.	Mixer hours.		Concrete placed.		
	Average number.	Size.		Total.	Per day.	Total.	Per day.	Per mixer hour.
December, 1912.	1.00	<i>Cu. yds.</i> 1	2	14.50	7.25	<i>Cu. yds.</i> 315	<i>Cu. yds.</i> 157.50	<i>Cu. yds.</i> 21.7
January, 1913.	1.00	1	25	169.00	6.76	3,641	145.64	21.5
February.	1.41	1	22	160.00	7.27	3,457	157.14	21.6
March.	1.00	$\frac{1}{2}$	5	31.00	6.20	346	69.20	11.2
April.	1.80	1	25	259.50	10.38	5,705	228.20	21.9
May.	1.00	$\frac{1}{2}$	6	30.00	5.00	266	44.33	8.9
June.	1.41	1	22	154.50	7.02	2,853	129.68	18.5
May.	1.54	$\frac{1}{2}$	26	268.25	10.32	6,415	246.73	23.9
June.	1.00	$\frac{1}{2}$	20	138.25	6.91	2,813	140.60	20.3
June.	1.84	1	25	360.75	14.41	9,537	381.48	26.5
June.	1.00	$\frac{1}{2}$	17	119.00	7.00	3,203	188.41	26.9
Totals:								
1-yard mixers.	1.43	1	147	1,386.50	9.43	31,923	217.16	23.0
One-half-yard mixers.	1.00	$\frac{1}{2}$	48	318.25	6.63	6,628	138.08	20.8

## DRY EXCAVATION.

The excavation by steam shovels in the canal prism, south of the Miraflores Locks, and also between the Pedro Miguel and Miraflores Locks, was continued throughout the year, the spoil being used for the back filling of the lock walls, filling dams, and the filling in of swamp areas on the east and west sides of the canal.

In order to more equally divide the excavation by steam shovels and by dredges, a new dike was built across the canal prism at station 2111, or approximately 3,300 feet north of the old dike. After closing down the hydraulic excavating plant on December 1, 1912, which had excavated the area between these dikes to rock at elevation approximately minus 20, the area was drilled to grade, or minus 45 feet below mean sea level, and blasted, preparatory to being excavated by dredges after the area was rewatered. After the area was blasted and previous to turning the water in, steam shovels took out 59,000 cubic yards in the dry. The south dike was then drilled to grade and blown up on May 18, using 33,000 pounds of 60 per cent dynamite, permitting the water to enter between the dikes, after which the dredges proceeded with the excavation. Prior to blowing up of dike, however, water was brought up to mean sea level by the use of pumps, siphons, etc., to prevent injury to new dike by the inrush of water.

TABLE No. 20.—*Dry excavation in canal prism.*

Month.	Steam shovels.		Plant.	Total (work).
	Earth.	Rock.		
1912.	<i>Cubic yds.</i>	<i>Cubic yds.</i>	<i>Cubic yds.</i>	<i>Cubic yds.</i>
July.....	72,055	80,500	.....	152,555
August.....	89,576	93,994	.....	183,570
September.....	95,253	47,755	.....	143,008
October.....	52,323	167,636	.....	219,959
November.....	62,466	175,112	.....	237,578
December.....	81,352	221,096	.....	302,448
1913.				
January.....	114,787	293,180	.....	407,967
February.....	106,752	225,026	1,522	331,778
March.....	134,300	231,700	5,700	366,000
April.....	140,597	234,483	.....	375,080
May.....	81,536	179,478	.....	261,014
June.....	67,084	162,810	.....	229,894
Total.....	1,098,081	2,112,770	7,222	3,210,851

The details showing the performance of steam shovels during the fiscal year are given in the following tables:

TABLE No. 21.—*Performance of steam shovels at Pedro Miguel.*

Month.	Average number of shovels working.	Hours under steam.	Hours working.	Material loaded per month.				Rainfall.
				Earth.	Rock.	Total.	Average per hour under steam.	
1912.				<i>Cubic yds.</i>	<i>Cubic yds.</i>	<i>Cubic yds.</i>	<i>Cubic yds.</i>	<i>Inches.</i>
July.....	2.61	544	106.75	27,419	.....	27,419	50.40	11.54
August.....	2.66	592	131.00	32,047	.....	32,047	54.13	9.51
September.....	2.21	432	117.92	18,028	.....	18,028	41.73	10.76
October.....	1.41	304	123.75	17,252	.....	17,252	56.75	10.48
November.....	1.95	280	83.25	20,096	.....	20,096	71.77	8.43
December.....	2.00	400	174.33	26,152	1,867	28,019	70.05	3.91
1913.								
January.....	2.62	544	277.42	42,470	.....	42,470	78.07	1.10
February.....	2.87	528	262.25	40,719	.....	40,719	77.12	.07
March.....	3.96	792	479.58	69,000	.....	69,000	87.12	.00
April.....	3.88	808	500.83	50,051	.....	50,051	61.92	1.04
May.....	1.58	328	166.08	21,711	.....	21,711	66.13	13.48
June.....	1.00	200	128.25	12,814	.....	12,814	64.07	9.00
Total.....	2.40	5,752	2,551.41	377,759	1,867	379,626	66.00	79.32

TABLE NO. 22.—*Performance of steam shovels at Miraflores.*

Month.	Average number of shovels working.	Hours under steam.	Hours working.	Material loaded per month.				Rainfall.
				Earth.	Rock.	Total.	Average per hour under steam.	
1912.				<i>Cubic yards.</i>	<i>Cubic yards.</i>	<i>Cubic yards.</i>	<i>Cubic yards.</i>	<i>Inches.</i>
July.....	6.19	1,849	496.58	48,500	80,500	129,000	69.76	8.37
August.....	7.96	2,524	573.42	58,745	94,838	153,583	60.42	11.35
September.....	9.67	2,604	887.95	77,289	47,755	125,044	48.02	14.45
October.....	9.33	2,989	994.00	35,071	176,969	212,040	70.94	15.44
November.....	10.51	2,854	979.58	43,777	195,926	239,703	83.98	11.89
December.....	10.84	3,158	1,317.08	56,755	235,089	291,844	92.41	6.75
1913.								
January.....	10.84	3,384	1,556.33	74,862	305,656	380,518	112.45	2.65
February.....	11.26	3,108	1,401.17	67,555	225,026	292,581	94.14	2.49
March.....	11.88	3,564	1,539.08	68,100	256,900	325,000	91.19	.00
April.....	11.81	2,998	1,490.75	98,606	245,641	344,247	114.82	0.79
May.....	9.46	2,047	1,231.34	59,825	179,478	239,303	116.90	12.33
June.....	8.76	1,832	1,013.75	54,270	162,810	217,080	118.49	9.49
Total.....	9.88	32,911	13,481.03	743,355	2,206,588	2,949,943	89.63	96.00

## MINING.

The following mining work was performed in connection with the dry excavation at Miraflores and Pedro Miguel:

TABLE NO. 23.—*Mining.*

Item.	Unit.	Pedro Miguel.	Miraflores.	Total.
Drilling with power drills.....	Linear feet.....	15,232	1,049,642	1,064,874
Drilling with hand drills.....	do.....			
Average number of feet drilled per cubic yard of material excavated.....	do.....	0.04	0.359	0.320
Explosives used.....	Gross tons.....	2.13	579.33	581.460
Average number of pounds of dynamite used per cubic yard of material excavated.....	Pounds.....	0.013	0.437	0.391

## THIRD DISTRICT.

## MUNICIPAL AND SANITARY WORK.

[W. G. Spalding, assistant engineer.]

## MUNICIPAL ENGINEERING.

This department operates and maintains certain permanent plants and makes all municipal improvements within the division, including the city of Panama. The permanent plants are the Ancon pumping and filtration station, Cocoli pumping station, and the Rio Grande and Cocoli reservoirs.

## ANCON PUMPING AND FILTRATION STATION.

The only change made in this station during the year was the moving of the two 8 by 20 foot pressure filters from the basement of the Miraflores power house and installing the same at the Ancon filtration plant, thus increasing the filter units at this plant to five. By this

arrangement the water from the Rio Grande and Cocoli reservoirs was served for domestic use to Pedro Miguel, Miraflores, and Corozal without filtering, but the change was necessary on account of the increased consumption at Ancon and Panama overrunning the capacity of the filters.

This plant was maintained and operated at a cost shown in Table No. 24.

TABLE NO. 24.—*Details of work and cost: Ancon pumping and filtration station.*

Month.	Water pumped.	Cost of pumping.			
		Labor.	Material.	Total.	Per 1,000 gallons.
1912.	<i>Gallons.</i>				
July.....	14,195,000	\$369.09	\$699.41	\$1,068.50	\$0.0753
August.....	12,754,000	423.87	690.48	1,114.35	.0890
September.....	15,656,000	380.18	720.62	1,100.80	.0763
October.....	14,426,000	488.36	729.14	1,217.50	.0844
November.....	13,218,000	341.90	573.34	915.24	.0692
December.....	15,817,000	261.82	638.45	900.27	.0570
1913.					
January.....	18,691,000	280.43	406.76	687.19	.0367
February.....	29,699,000	263.72	398.46	662.18	.0222
March.....	35,613,000	305.42	589.80	895.22	.0251
April.....	35,393,000	324.02	629.20	953.22	.0269
May.....	36,853,000	337.81	748.85	1,086.66	.0294
June.....	32,859,000	417.11	525.49	942.60	.0287
Total.....	275,174,000	4,193.73	7,350.00	11,543.73	.0419

Month.	Water filtered.	Cost of filtering.			
		Labor.	Material.	Total.	Per 1,000 gallons.
1912.	<i>Gallons.</i>				
July.....	55,606,750	\$42.78	\$10.31	\$53.09	\$0.0009
August.....	65,770,500	15.47	153.28	168.75	.0026
September.....	62,524,000	12.39	6.22	18.61	.0003
October.....	64,194,750	13.92	89.04	102.96	.0016
November.....	61,458,250	103.77	453.38	557.15	.0090
December.....	70,142,000	28.41	83.51	111.92	.0016
1913.					
January.....	77,330,000	43.76	110.38	154.14	.0019
February.....	85,778,000	49.35	.26	49.61	.0005
March.....	96,800,000	63.28	183.52	246.80	.0025
April.....	91,374,000	79.90	180.53	260.43	.0028
May.....	86,365,000	61.83	584.03	645.86	.0074
June.....	84,780,000	58.89	141.67	200.56	.0024
Total.....	902,123,250	573.75	1,996.13	2,569.88	.0028

#### COCOLI PUMPING PLANT.

This station was operated throughout the year, supplying water from the Cocoli Reservoir to the Rio Grande supply main through two 10-inch discharge lines. The plant was described in the last annual report.

The cost of operation is given in Table No. 25.

TABLE No. 25.—*Details of work and cost: Cocoli pumping station.*

Month.	Water pumped.	Cost of pumping.			
		Labor.	Material.	Total.	Per 1,000 gallons.
1912.	Gallons.				
July.....	178,560,000	\$479.89	\$4,423.88	\$4,903.77	\$0.0219
August.....	178,560,000	441.38	4,553.51	4,994.89	.0280
September.....	65,371,800	399.39	291.61	691.00	.0106
October.....	41,144,000	465.07	267.79	732.86	.0177
November.....	27,216,000	305.51	43.52	349.03	.0128
December.....	113,180,000	318.08	2.23	320.31	.0028
1913.					
January.....	163,285,500	499.64	1,889.86	2,389.50	.0140
February.....	166,288,500	655.72	370.55	1,026.27	.0062
March.....	173,365,500	736.31	177.60	913.91	.0052
April.....	161,390,000	531.90	243.27	775.17	.0048
May.....	172,647,300	690.06	838.84	1,528.90	.0088
June.....	141,186,500	468.27	2,065.20	2,533.47	.0179
Total.....	1,582,195,100	5,991.22	15,167.86	21,159.08	0.0134

## RIO GRANDE AND COCOLI RESERVOIRS.

These reservoirs supply Culebra and all points south, including the city of Panama, with water for both domestic and construction purposes. The consumption during the fiscal year from these reservoirs has been greater than in any previous year, and is shown in Table No. 26.

TABLE No. 26.—*Water consumption from Rio Grande and Cocoli Reservoirs.*

Fiscal year.	Reservoirs.		Total.
	Rio Grande.	Cocoli.	
	<i>Gallons.</i>	<i>Gallons.</i>	<i>Gallons.</i>
1905 <sup>1</sup> .....	(2)		
1906 <sup>1</sup> .....	(2)		
1907 <sup>3</sup> .....	(2)		
1908.....	942,200,000		942,200,000
1909.....	1,104,421,000		1,104,421,000
1910.....	1,259,771,000	38,179,000	1,297,950,000
1911.....	1,410,057,000	327,733,000	1,737,790,000
1912.....	1,184,681,370	871,045,000	2,055,726,370
1913.....	1,360,224,700	1,582,195,100	2,942,419,800

<sup>1</sup> Water first turned into main to Ancon on June 26, 1905, and into Panama on July 4, 1905.<sup>2</sup> No record.<sup>3</sup> Venturi meter installed January, 1907. No record of water consumption between date of installation of meter and July 1, 1907.

## RIO GRANDE RESERVOIR.

The Rio Grande Reservoir has been maintained at a total cost of \$3,630.47 for the year, and has furnished 1,360,224,700 gallons of water.

## COCOLI RESERVOIR.

The Cocoli Reservoir is a temporary water supply formed by the west dam at Miraflores and fed by the Cocoli River; it will subsequently be a portion of the Miraflores Lake.

The cost of maintaining this reservoir has been \$333.02, and it has supplied 1,582,195,100 gallons of water during the year.

The following is general information pertaining to the reservoirs:

TABLE NO. 27.—*Reservoirs.*

Detail.	Unit.	Rio Grande.	Cocoli.	Total.
Drainage area.....	Square miles.....	3.15	17.00	20.15
Maximum lake area.....	Acres.....	72.77	129.51	202.28
Elevation of spillway with flashboards.....	Feet.....	238.17	43.00	.....
Maximum depth of water.....	do.....	52.77	33.64	.....
Total capacity.....	Gallons.....	490,667,000	798,700,000	1,289,367,000
Storage at lowest elevation, 1912-13.....	do.....	94,504,000	373,235,000	467,739,000
Average daily consumption, 1912-13.....	do.....	3,753,452	4,600,720	8,354,172
Average daily consumption, city of Panama.....	do.....	.....	.....	1,745,058

The total amount of water consumed in the past year was 2,942,-419,800 gallons, including 626,949,250 gallons used in the city of Panama.

TABLE NO. 28.—*Consumption of water by districts, 1912-13.*

Month.	Panama.	Ancon high service.	Balboa (6-inch and 10-inch mains).	Cucaracha pump.
1912.	<i>Gallons.</i>	<i>Gallons.</i>	<i>Gallons.</i>	<i>Gallons.</i>
July.....	41,411,750	14,195,000	16,739,100	14,340,400
August.....	53,016,500	12,754,000	18,747,400	13,850,000
September.....	46,868,000	15,656,000	17,251,100	13,040,000
October.....	49,768,750	14,426,000	17,210,800	13,332,000
November.....	48,240,250	13,218,000	19,726,800	16,475,900
December.....	54,325,000	15,817,000	22,854,300	13,848,000
1913.				
January.....	58,639,000	18,691,000	23,918,300	12,746,000
February.....	56,079,000	29,699,000	18,169,700	10,156,000
March.....	61,187,000	35,613,000	22,208,000	13,875,000
April.....	55,981,000	35,393,000	23,465,200	14,600,000
May.....	49,512,000	36,853,000	24,516,800	15,200,000
June.....	51,921,000	32,859,000	29,551,900	13,723,000
Total.....	626,949,250	275,174,000	254,359,400	165,186,300

Month.	Pedro Miguel, Paraiso, Cucaracha, Miraflores, Corozal, and Ancon low service.	Source of supply.		
		Rio Grande Reservoir.	Cocoli Reservoir.	Total.
1912.	<i>Gallons.</i>	<i>Gallons.</i>	<i>Gallons.</i>	<i>Gallons.</i>
July.....	150,118,750	58,245,000	178,560,000	236,805,000
August.....	162,402,100	82,210,000	178,560,000	260,770,000
September.....	139,318,200	166,761,500	65,371,800	232,133,300
October.....	117,644,750	171,238,300	41,144,000	212,382,300
November.....	102,413,950	172,858,900	27,216,000	200,074,900
December.....	131,437,700	125,102,000	113,180,000	238,282,000
1913.				
January.....	138,905,200	89,614,000	163,285,500	252,899,500
February.....	139,186,800	87,002,000	166,288,500	253,290,500
March.....	130,024,500	89,542,000	173,365,500	262,907,500
April.....	138,873,800	106,923,000	161,390,000	268,313,000
May.....	143,506,500	96,941,000	172,647,300	269,588,300
June.....	126,918,600	113,787,000	141,186,500	254,973,500
Total.....	1,620,750,850	1,360,224,700	1,582,195,100	2,942,419,800

NOTE.—The consumption given for Pedro Miguel, Paraiso, Cucaracha, Miraflores, Corozal, and Ancon low service is the difference between the total consumption of the various other districts (which are metered) and the total supply.

## PANAMA IMPROVEMENTS.

The following municipal and sanitary improvements in the city of Panama have been made by the commission during the fiscal year:

One thousand two hundred and forty-four linear feet of 6-inch sewers were installed in the Chorillo district, and two concrete manholes constructed, for Mr. Ora Miller, at a total cost for labor, material, and supervision of \$717.15.

Damage to street work at the junction of C and Seventeenth Streets, caused by flood, was repaired by making 77 cubic yards of fill, laying 52 linear feet of 8-inch vitrified sewer pipe and 271 linear feet of concrete curb and gutter, at a cost of \$412.89.

New streets were built and paved with 2,562 square yards of macadam and 2,114 linear feet of concrete curbs and gutters laid in the vicinity of the new Panama Railroad station; also 12 catch basins were installed. The street grading required 2,035 cubic yards of excavation. The total cost of these improvements was \$4,127.82.

A 6-inch sewer lateral was installed to the property of Mr. Domingo Diaz, at the corner of I Street and the Zone Line Road, at a cost of \$10.31.

Five hundred and sixty linear feet of 8-inch and 33 linear feet of 6-inch vitrified sewer pipe were laid and two manholes constructed connecting the Panama Government stables on the Caledonia Road with the sewer main on Neveria Road, at a cost of \$233.80. Excavation and back fill amounted to 167 cubic yards.

An artesian well, 200 feet in depth, was drilled for the Panama Brewing & Refrigerating Co., at a cost of \$86.17.

Four hundred and seventy-one linear feet of concrete curbs and gutters were built along the south side of C Street from West Fourteenth to West Sixteenth Streets, also on the north side of C Street from West Fourteenth to West Fifteenth Streets, and C Street was macadamized with 522 square yards of paving between West Fourteenth and West Sixteenth Streets. Total cost, \$1,130.81.

One hundred square yards of vitrified brick paving was removed, 850 linear feet of cable ducts were installed and 5 manholes constructed, and pavement replaced, in connection with the construction of an underground conduit for the cables of the Central & South American Cable Co., from their office on Central Avenue to the beach. Cost of work, \$2,714.96.

West Sixteenth Street lying between B and C Streets was improved by the laying of 571 linear feet of concrete curb and gutter and 551 square yards of macadam paving, at a total cost of \$1,631.39.

## NEW TOWN SITE AND ADMINISTRATION BUILDING, BALBOA.

Work in connection with the layout of the permanent town site and administration building was started in March. Surveys were also made for the Marine reservation, adjacent to the new town site and in the vicinity of the Ancon quarry.

After the general plans of the town site were made and the drainage areas determined outfall storm sewers were designed and construction work started as follows: Seven hundred and fifty linear feet of 5½ by 8 foot reenforced concrete storm sewer from the old iron bridge southward to the sea; also 1,222 linear feet of 3 by 3 foot reenforced concrete drain from the electric light plant in a southeasterly direction,



which will subsequently be a branch of the main outfall storm sewer, was practically completed.

A new 20-foot macadam highway was partially constructed around the south side of Sosa Hill to the Panama Railroad docks, and the portion from the Union Oil Co.'s plant to the docks was graded and the metal placed and practically completed for a total length of approximately 2,050 feet.

A portion of the town-site district, on the north side of Sosa Hill and between the Balboa Road and the Panama Railroad yard, was filled hydraulically with material pumped by dredge *No. 85* from the Balboa inner harbor excavation, which brought this territory up from elevation approximately plus 14 to plus 20.

A layout for the permanent laborers' barracks on the south side of Sosa Hill was made and the construction work for sewer systems started.

The location of the new administration building on a knoll on the west side of the Ancon Hill was approved, and excavation by steam shovel of approximately 36,500 cubic yards was required in order to grade the site preparatory to the installation of foundations. The concrete piers for the columns were installed, and the contractors began the erection of the steel frame of the superstructure on June 18

#### ZONE WATERWORKS.

The water mains were patrolled and maintained and all necessary house connections, standpipes, and fire hydrants installed.

On account of the future inundation it was necessary to take up the old 16-inch Rio Grande water-supply main between Pedro Miguel and the Miraflores power house and relay the same along the Panama Railroad line, which is above the future level of the Miraflores Lake. This main was taken up and partially relaid at the close of the fiscal year.

On account of the construction work of the locks and spillway dam, it was necessary to relay portions of the 10-inch supply mains between the Cocoli pumps and the junction with the 16-inch main at the Miraflores power house.

Water-supply mains were constructed and changed from time to time, as required, for construction purposes.

Water connections were made to 83 houses during the year at a total cost of \$4,992.98.

A detailed statement of waterworks construction is shown in Table No. 29.

TABLE No. 29.—*Zone waterworks construction.*

Item (class of pipe).	Unit.	Item (class of pipe).	Unit.
	<i>Linear feet.</i>		<i>Linear feet.</i>
20-inch cast iron.....	228	6-inch black iron.....	5,680
16-inch cast iron.....	7,631	6-inch galvanized iron.....	2,465
10-inch cast iron.....	4,820	6-inch wrought iron.....	430
10-inch black iron.....	120	5-inch galvanized iron.....	2,065
8-inch cast iron.....	2,560	4-inch galvanized iron.....	13,145
7-inch black iron.....	340	3-inch galvanized iron.....	1,380
6-inch cast iron.....	3,656	2-inch galvanized iron.....	440
Total.....	19,355	Total.....	25,605
		Grand total.....	44,960

TABLE NO. 30.—*Cost of maintenance and repairs, Zone waterworks.*

	Labor.	Material. <sup>1</sup>	Total.
Balboa district.....	\$835.62	\$223.66	\$1,059.28
Ancon district.....	1,054.48	388.22	1,442.70
Corozal district.....	258.93	33.88	292.81
Miraflores district.....	677.26	81.58	758.84
Pedro Miguel district.....	5,053.83	884.11	5,937.94
Inspection of water lines.....	681.12	18.12	699.24
Water analyses.....	1,886.00	601.51	2,487.51
Total.....	10,447.24	2,231.08	12,678.32

<sup>1</sup> Materials have been reclaimed and second-hand material used in many instances.

## ZONE SEWER SYSTEM.

The work performed during the year consisted in laying new sewer mains, making extensions, and general maintenance, as shown in Tables Nos. 31 and 32.

TABLE NO. 31.—*Statement of work performed on sewers, fiscal year 1912-13—Sewers installed.*

District.	Linear feet.	Size.	Labor.	Material.	Total.
		<i>Inches.</i>			
Balboa district.....	{ 1,567 1,178 160	{ 6 8 4	\$295.02	\$525.03	\$820.05
Ancon district.....	{ 1,017 1,419	{ 6 8	766.37	335.80	1,102.17
Corozal district.....	{ 5,447 1,785	{ 6 8	1,846.05	1,132.18	2,978.23
Miraflores district.....	566	6	56.91	38.32	95.23
Pedro Miguel district.....	769	6	43.83	27.18	71.01
Total.....	13,908	.....	3,008.18	2,058.51	5,066.69

TABLE NO. 32.—*Sewer maintenance.*

	Labor.	Material.	Total.
Balboa district.....	\$414.67	\$8.19	\$422.86
Ancon district.....	473.87	24.97	498.84
Corozal district.....	64.71	5.12	69.83
Miraflores district.....	41.01	30.58	71.59
Pedro Miguel district.....	602.05	48.46	650.51
Total.....	1,596.31	117.32	1,713.63

## ZONE ROADS.

Existing roads, including the Savanas Road from the Caledonia Bridge to outer Zone line, have been maintained and repaired throughout the division, as required.

A new macadam road is being constructed from Diablo to Ancon, and is being partially built by Zone prison labor. This road follows for some distance the old roadbed of the Panama Railroad, thence along the east side of the Panama Railroad main line on a fill, crossing the main line at the blockhouse, and thence to the junction with the Tivoli Road at Ancon. A 20-foot span reinforced concrete bridge for

this highway is being constructed across the Curundu River. The grading was completed and the macadam partially placed and rolled at the close of the fiscal year.

TABLE NO. 33.—*Maintenance and repairs, Canal Zone roadways.*

	Labor.	Material.	Total.
Balboa district.....	\$3,904.73	\$3,783.62	\$7,688.35
Ancon district.....	2,597.69	2,056.74	4,654.43
Savanas Road.....	1,800.81	7,657.00	9,457.81
Tumba Muerta Road.....	2,569.17	3,833.60	6,402.77
Corozal district.....	4,424.31	3,438.64	7,862.95
Miraflores district.....	2,265.56	1,803.54	4,069.10
Pedro Miguel district.....	616.31	270.26	886.57
Total.....	18,178.58	22,843.40	41,021.98

## MACADAMIZING AND OILING ROADS (MAINTENANCE).

Roads.	Labor.	Material.			Total.
		Macadam and oil.		Other than macadam and oil.	
		Macadam.	Oiling.		
Hospital roads.....	\$973.07	\$1,361.82	\$469.28	\$1,277.59	\$4,081.76
Zone Line Road.....	306.33	365.59	543.74	816.17	2,031.83
Balboa Road.....	478.62	391.81	241.07	921.35	2,032.85
Total.....	1,758.02	2,119.22	1,254.09	3,015.11	8,146.44

## SANITARY WORK.

The sanitary work consisted of digging and cleaning ditches, laying concrete and tile drains, filling swamp lands, and other work of similar character, by the request of and in accordance with plans prepared by the sanitary department. The work performed during the fiscal year is shown in Table No. 34.

TABLE NO. 34.—*Statement of sanitary work performed, 1912-13.*

Class of work.	Unit.	Quantity.	Labor.	Material.	Total.	Unit cost.
Cleaning earth drains.....	Linear feet.....	593,127	\$13,872.65	\$81.64	\$13,954.29	\$0.0234
Excavating new earth drains.....	Cubic yards.....	5,079	4,519.66	29.35	4,549.01	.893
Sweeping cement drains.....	Linear feet.....	1,023,382	2,913.13	94.30	3,007.43	.0029
Filling holes and swamps.....	Cubic yards.....	2,862	2,343.51	.....	2,343.51	.819
Laying tile drains.....	Linear feet.....	2,520	967.22	230.82	1,198.04	.475
Constructing cement drains.....	do.....	10,566	1,973.61	458.67	2,432.28	.230
Repairing cement drains.....	.....	.....	516.69	99.25	615.94	.....
Cleaning culverts.....	.....	.....	185.13	32.29	217.42	.....
Repairing tile drains.....	.....	.....	36.41	10.26	46.67	.....
Installing pipe culverts.....	.....	.....	35.23	43.84	79.07	.....
Maintaining oil tanks.....	.....	.....	596.59	296.31	892.90	.....
Clearing land of vegetation (reservoir banks, etc.).	Acres.....	131	3,186.39	136.89	3,323.28	24.32
Total.....	.....	.....	31,146.22	1,513.62	32,659.84	.....

## FOURTH DISTRICT.

## ANCON QUARRY AND CRUSHERS.

[J. A. Loulan, superintendent.]

The Ancon quarry has been operated throughout the year with a comparatively small amount of time lost for repairs.

This plant has been operated for about three years without a shut-down for general overhauling, until May 16. The plant was shut down for 10 days, during which time the various repair parts were put in, including shaft in main crusher, general overhauling to the four No. 6 crushers, lining up of screens, motors, driving shafts, etc. New floors were put in around crushers, and new bracing put into bins, which had almost completely worn out.

One of the small No. 5 gyratory crushers was brought from the old Rio Grande quarry and installed on the floor of the south end of the rock bins, for the purpose of crushing a portion of the No. 1 grade of rock in order to supply the increased demand for No. 2 rock.

The quarry was run a portion of the year 12 hours a day in order to supply the demand. The performance of the plant is given in Table No. 35.

TABLE NO. 35.—Performance of Ancon quarry and crushers.

Month.	Num-ber of 8-hour shovel days.	Average number of shovels.	Material excavated.		Number of cubic yards of rock crushed (car measurement).				
			Stripped.	Quarried.	Placed in storage.	Supplied other work.			Total pro-duction.
						Municipal depart-ment.	Other fifth division work.	Other divisions, depart-ments, etc.	
1912.			<i>Cubic yds.</i>	<i>Cubic yds.</i>					
July.....	73	2.73	12,870	64,770	46,706	1,137	6,993	6,217	61,053
August.....	54	2.00	150	71,175	62,856	712	3,100	3,715	70,383
September.....	48	2.00	1,300	45,525	30,241	928	3,084	7,126	41,379
October.....	54	2.00	40	58,230	45,240	2,372	5,404	8,588	61,604
November.....	49	2.00	975	51,390	32,460	1,355	11,055	9,178	54,048
December.....	50	2.00	1,200	54,990	41,037	1,273	7,576	7,734	56,620
1913.									
January.....	52	2.00	270	71,895	44,122	925	5,722	19,419	70,188
February.....	46	2.00	2,040	61,544	37,120	1,650	3,055	19,719	61,544
March.....	51	2.00	1,600	65,400	36,662	1,162	6,848	21,071	65,743
April.....	52	2.00	760	50,100	17,175	1,667	10,329	20,921	50,092
May.....	44	1.69	22,555	29,274	.....	3,571	6,578	19,125	29,274
June.....	64	2.46	10,125	52,515	31,231	4,549	12,085	18,498	66,373
Total....	637	2.07	54,185	676,808	424,850	21,301	80,829	161,311	688,301

## MINING.

The following amount of drilling was done during the fiscal year:

Drilling with power drills.....	linear feet..	45,289
Drilling with hand drills.....	do....	400
Total.....		45,689

## EXPLOSIVES USED.

Dynamite.....	gross tons..	91.75
Black powder.....	do....	0.39
Total.....		92.14
Average number of linear feet drilled per cubic yard.....		0.067
Average number of pounds of explosives used per cubic yard.....		0.305

## HYDRAULIC EXCAVATION.

[W. L. Thompson, assistant engineer.]

The hydraulic excavating plant was in operation in the canal prism, south of Miraflores Locks, until December 1, 1912, at which time it was taken out of service owing to the fact that the remainder of the excavation was mostly hard rock, and also in order to provide additional space for steam-shovel and dredging operations. The excavated material was used for reclaiming tidal swamp land east of and adjacent to the canal prism. During the fiscal year 476,949 cubic yards were excavated.

TABLE No. 36.—*Hydraulic excavation, Miraflores.*

Month.	Plant.	Prism.	Spillway.	Total.
	<i>Cubic yards.</i>	<i>Cubic yards.</i>	<i>Cubic yards.</i>	<i>Cubic yards.</i>
1912.				
July.....		85,000		85,000
August.....		75,031		75,031
September.....	15,422	117,337	3,000	135,759
October.....		88,963	6,896	95,859
November.....		85,300		85,300
December.....				
Total this year.....	15,422	451,631	9,896	476,949
Previous to July 1, 1912.....		1,098,273		
Total to date.....		1,549,904		

After preliminary studies and estimates had been made in connection with the slides in the vicinity of Gold Hill, the chief engineer decided to move a portion of the hydraulic plant and install the same for the purpose of removing the high ground in the vicinity of slides just north of Gold Hill, by sluicing it back into the Obispo swamp. This project being approved, work on the installation of the hydraulic pumping mains and flumes was started on February 1, 1913. Two of the boilers and two of the Worthington pumps, having a combined capacity of 15,000 gallons per minute, were dismantled and moved to the site and installed ready for operations on June 17, 1913.

In order to provide sufficient water for pumping and sluicing operations a lake was formed by damming the Obispo River, thus forming a swamp lake of approximately 180 acres with a drainage area of 4 square miles. The elevation at the bottom of the suction at the pumping plant is plus 214, and the elevation at the spillway crest is plus 228. Owing to the distance of the pumping plant from the discharge of the flumes into the lake area, the water used in the sluicing work is returned to the lake and used over again, thus requiring a small inflow in order to keep the lake at a constant elevation. In view of the fact that the Obispo River never goes dry, it is contemplated that sluicing operations may be continued throughout the dry seasons if desired.

Six thousand five hundred feet of discharge mains were laid from the pumping plant to the sluicing district, and supply the water at approximately 80 pounds pressure for the operation of one 7-inch and one 4-inch monitor.

Preliminary operations began on June 17, 1913, consisting of washing out the flumes and getting the monitors worked into position, after which seven days' actual sluicing work was carried on during the month, excavating 57,000 cubic yards, or an average of 8,000 cubic yards per day.

Booster pumps have been ordered and will subsequently be installed on the extended mains in order to boost the pressure for the purpose of sluicing the high ground in the rear of Cucaracha slide and carrying the material back into the swamp. When operating in this vicinity it is contemplated that the sluicing plant may be used in order to assist moving material of the Cucaracha slide into the Cut after the water has been let in, thereby assisting the suction dredges in the quick and complete removal of the slide.

### DESIGNS, MAPS AND OFFICE WORK.

In addition to the routine work on progress records, estimates, specifications, requisitions, etc., for the various districts of the division, there have been prepared, when necessary, designs for numerous minor structures, detail work drawings for lock construction, mechanical designs for new apparatus and repair parts for the same, work request drawings for shop orders, building permit plans, etc.

For the annual report all necessary figures were compiled and arranged; nine plates were made.

There were prepared maps showing the sanitary ditches and grass-cutting areas for Pedro Miguel, Miraflores, Corozal, Balboa, and Ancon; a topographical map of Rio Grande Reservoir and surroundings; map showing Schubert property; map of high tide contour from Diablo to Rio Curundu, and map showing proposed dumps at Pedro Miguel with relocated houses and sewers.

The following plans were made: For dam and core wall at site of old spillway west of Cocoli Hill; reenforced concrete footings for columns of shop buildings, Balboa terminals; arrangement for storing crushed rock at Ancon quarry; trestle across northwest lock chamber at Miraflores; trestle across northwest lock chamber at Pedro Miguel; Gold Hill sluicing project, and Cucaracha extension of pipe line; spur track for handling building material at Corozal; erection of auxiliary rock crusher inside of rock bin at Ancon quarry; concrete girder support for lamp and snubbing posts on the lock walls. Studies were made of a layout for a concrete tile manufacturing plant.

For the municipal department, plans were prepared for an additional span to the Cardenas River highway bridge, for the foundations of the permanent administration building; plans and estimates for sewer and water systems for the Bella Vista estate; a layout of the new town of Balboa, and 12 plans in connection with the permanent Rio Grande water supply, showing layout profile of the whole system, hydraulic gradient for different conditions of discharge, and details of filter pipe connections and filter house.

For the sanitary department plans were made of a mosquito trap, of a device to determine the direction of flight of mosquitoes, and various diagrams and profiles.

One hundred and sixty-nine complete drawings were made, and 3,673 blue and white prints issued.

Very respectfully,

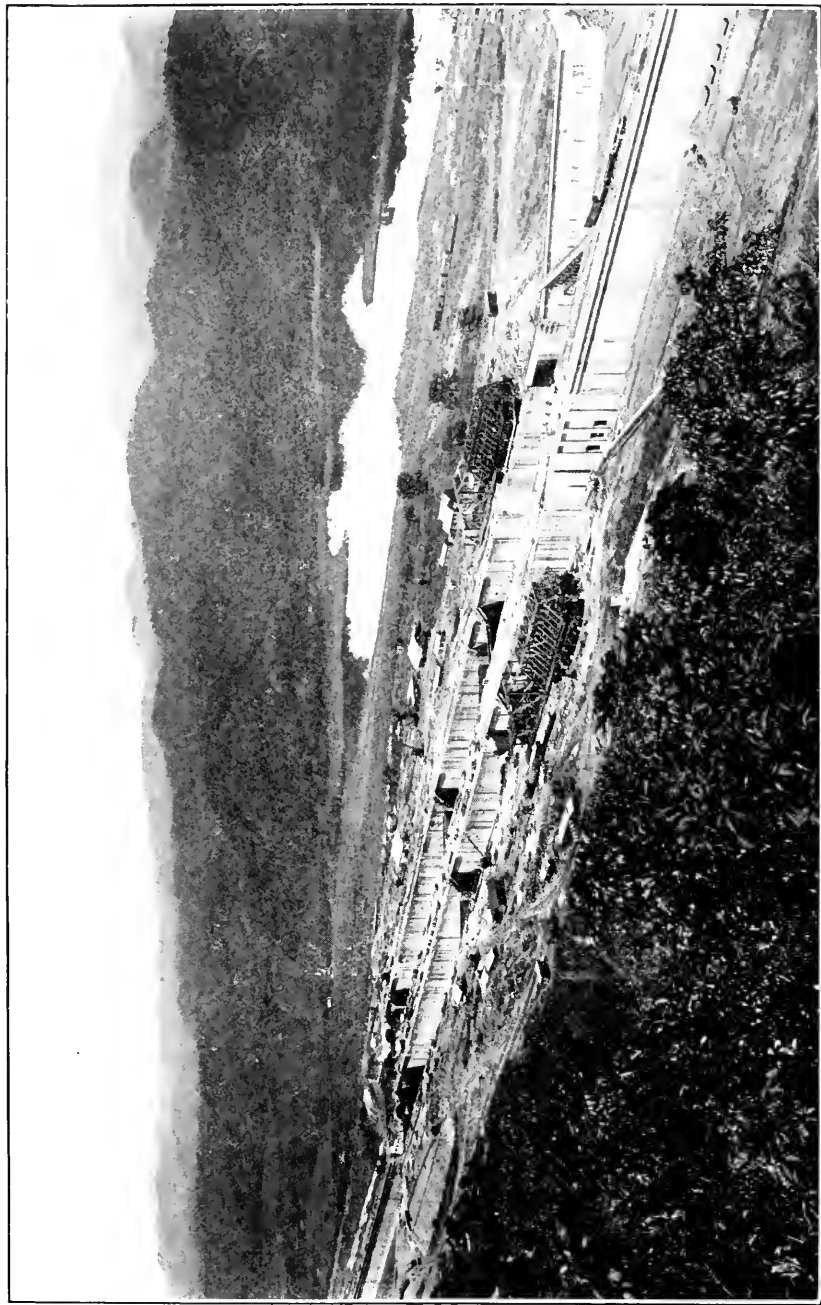
H. O. COLE,

*Resident Engineer, Fifth Division.*

Col. GEO. W. GOETHALS, United States Army,

*Chairman and Chief Engineer,*

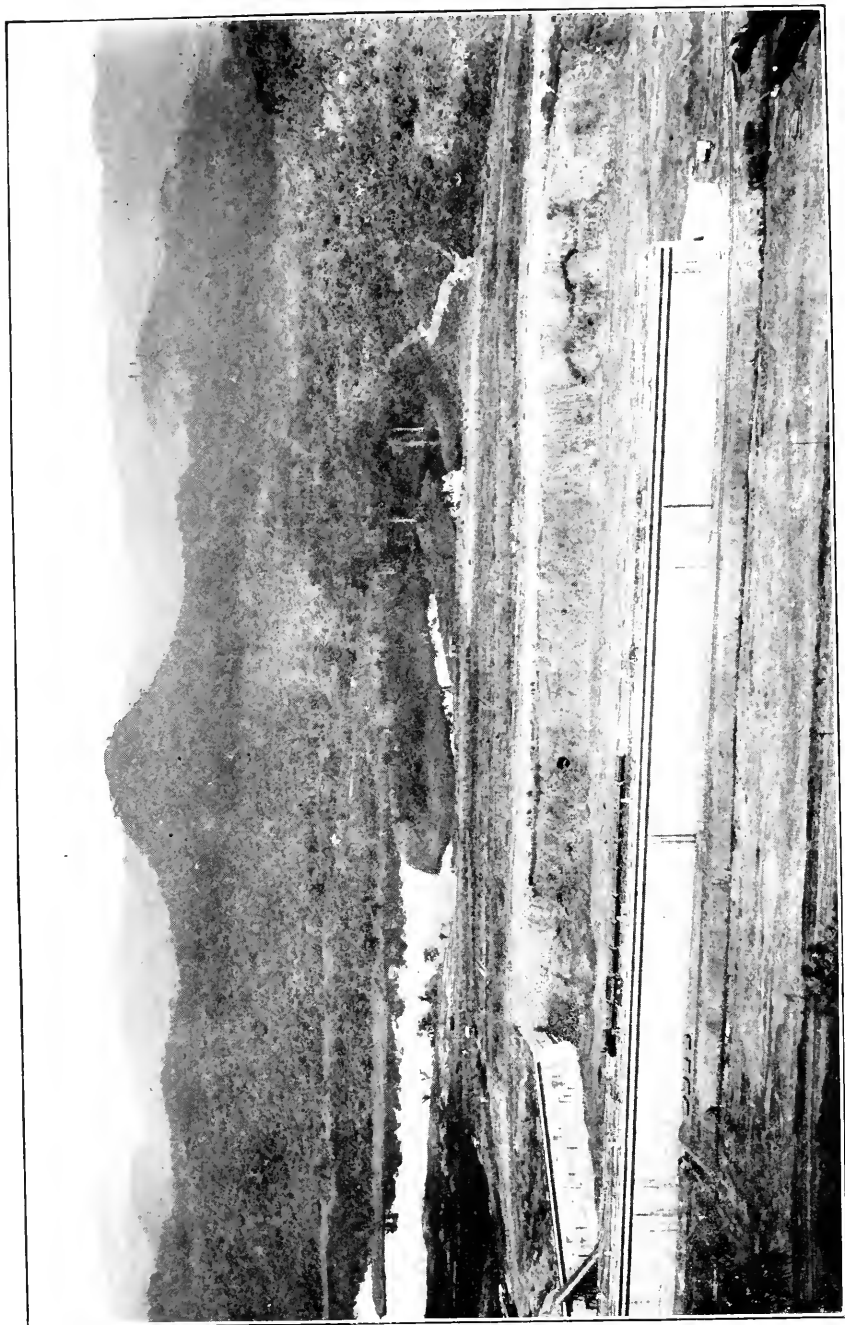
*Culebra, Canal Zone.*



BIRD'S-EYE VIEW, PEDRO MIGUEL LOCKS. JUNE, 1913.

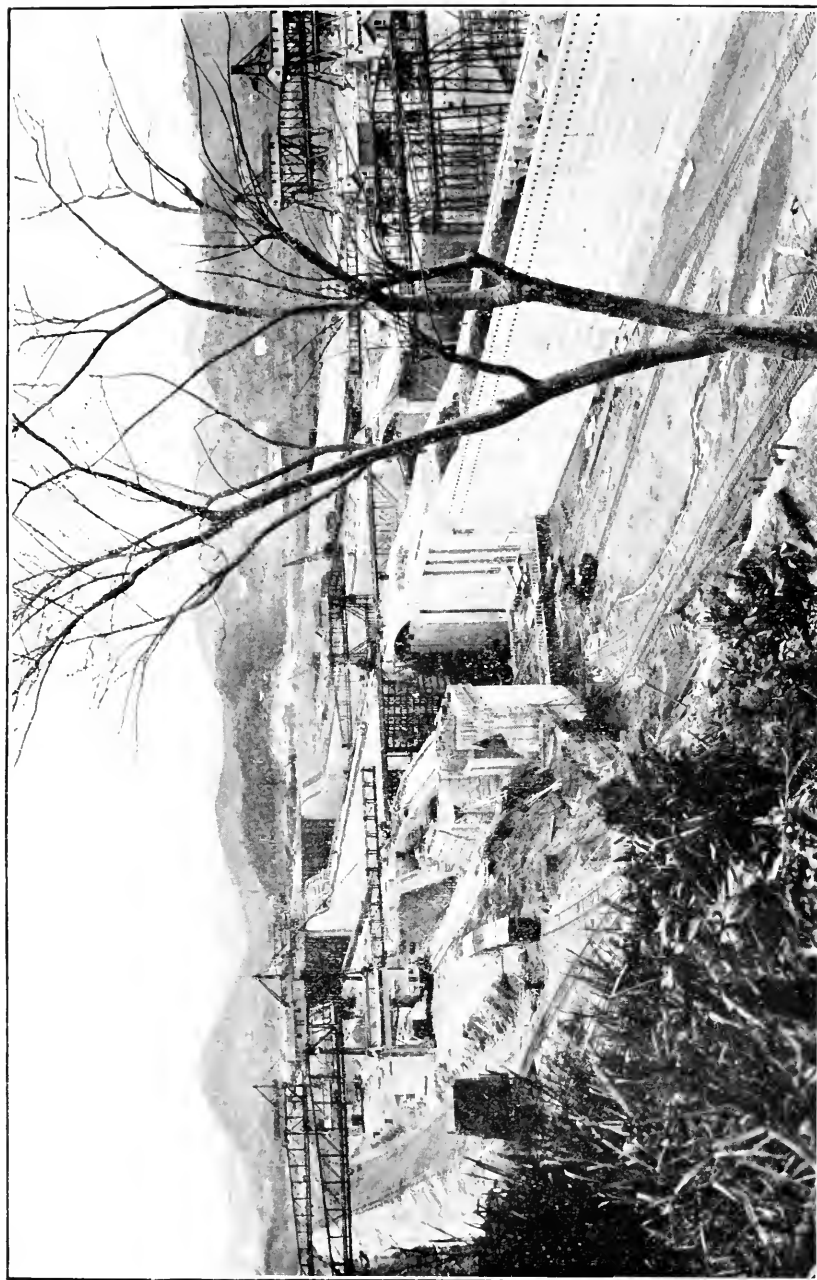






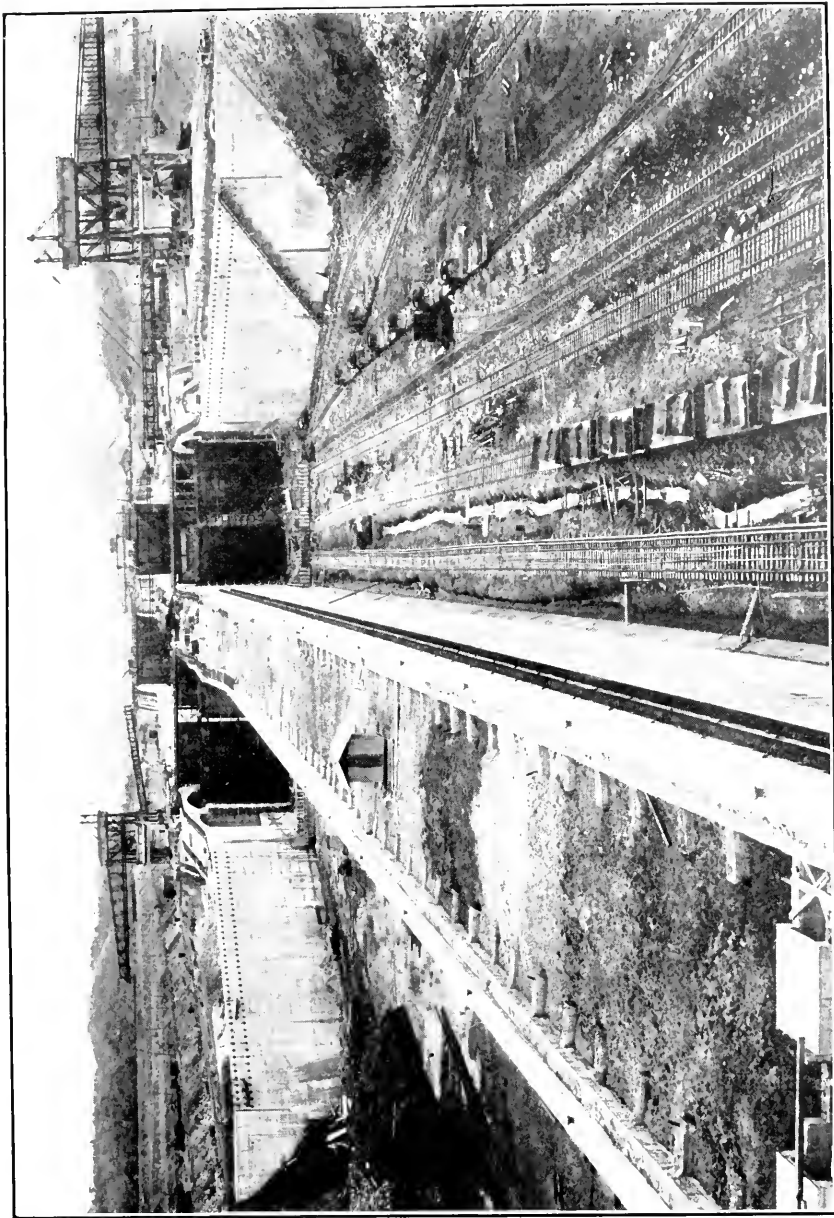
NORTH GUIDE WALL AND WEST DAM, PEDRO MIGUEL. JUNE, 1913.



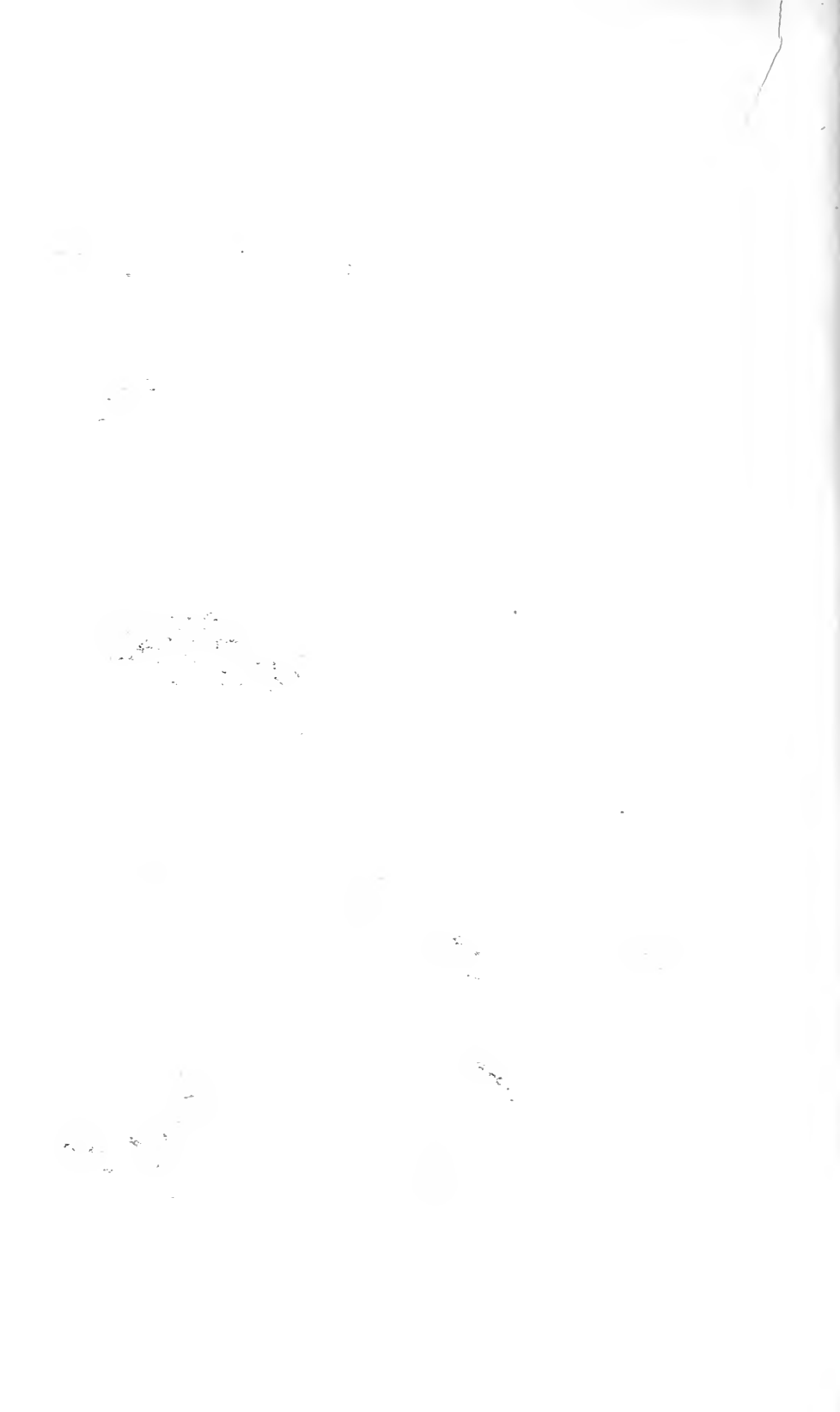


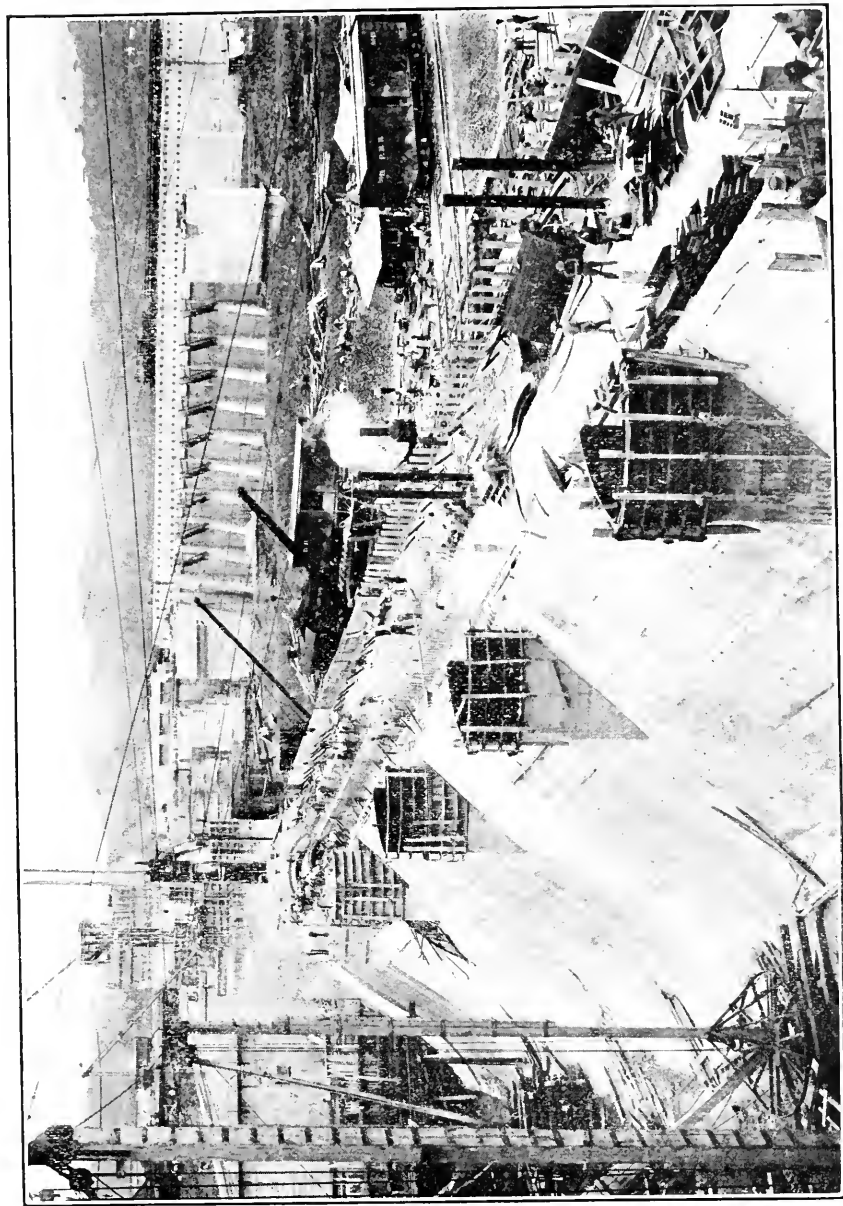
MIRAFLORES LOWER LOCKS, LOOKING NORTH FROM WEST BANK, SHOWING UPPER LOCKS IN THE DISTANCE. APRIL 16, 1913.





MIRAFLORES LOWER LOCKS. SOUTH GUIDE WALL, LOOKING NORTH. JUNE, 1913.

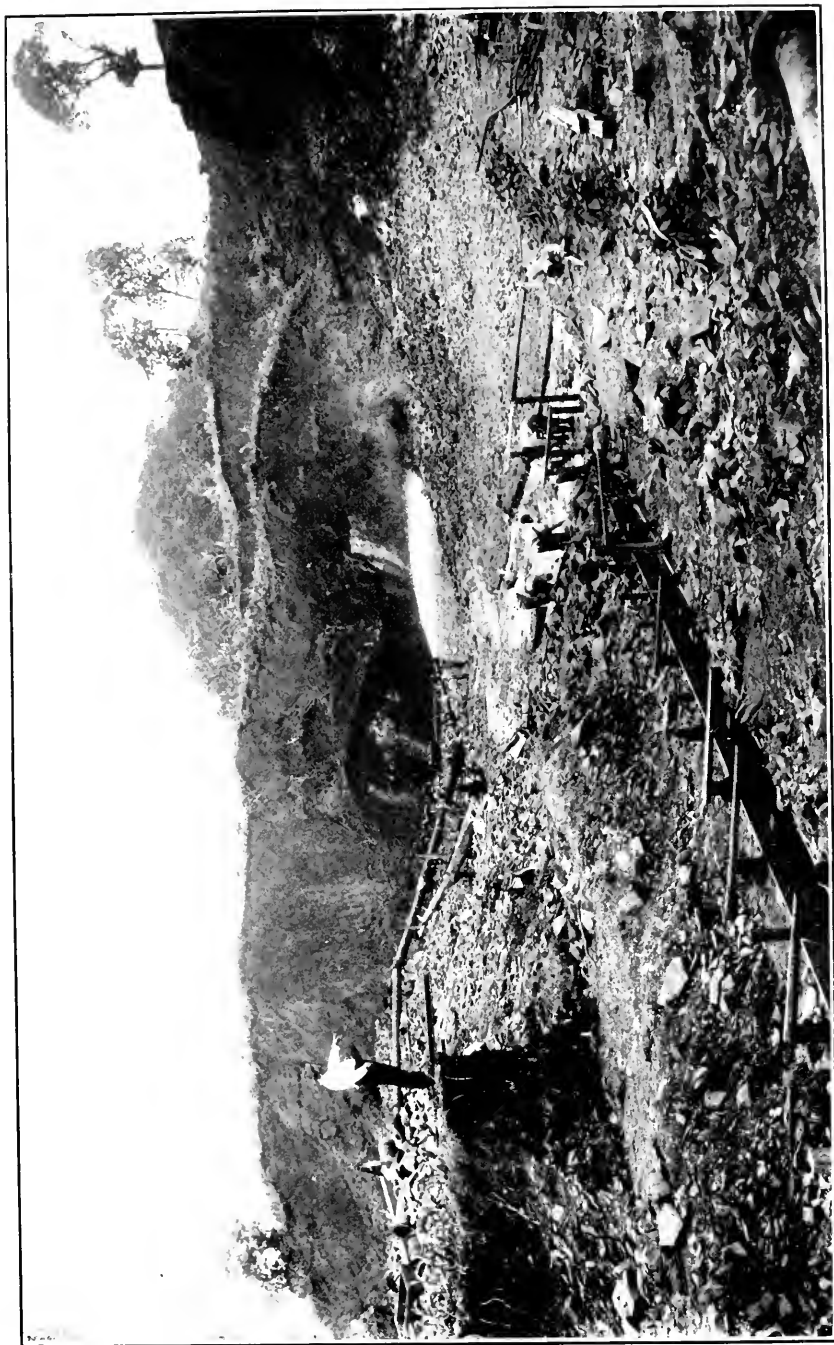




MIRAFLORES SPILLWAY DAM, LOOKING TOWARD LOCKS. JULY 5, 1913.







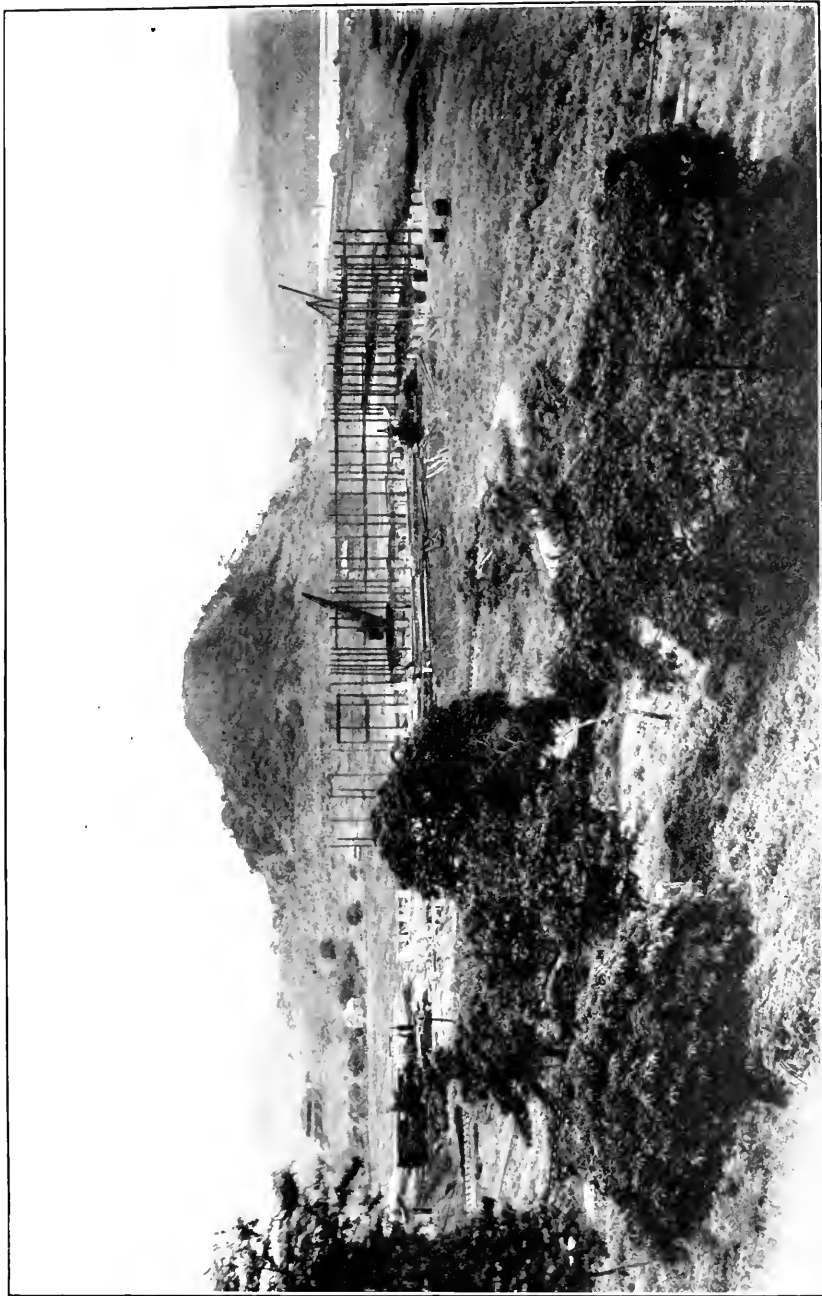
HYDRAULIC SLUICING NORTH OF GOLD HILL. JULY 22, 1913.





SEA-LEVEL SECTION. BLOWING UP THE SECOND DIKE SOUTH OF MIRAFLORES LOCKS TO ENABLE DREDGES TO ENTER AND COMPLETE EXCAVATION TO LAST DIKE BETWEEN PACIFIC OCEAN AND MIRAFLORES LOCKS. AMOUNT OF DYNAMITE USED WAS  $16\frac{1}{2}$  TONS, IN ABOUT 120 HOLES, 60 TO 70 FEET DEEP. MAY 18, 1913.





BEGINNING THE ERECTION OF STEEL FRAME FOR THE PERMANENT ADMINISTRATION BUILDING AT BALBOA. CANAL AND  
BALBOA TERMINAL SHOPS AT THE RIGHT, JUNE, 1913.



## APPENDIX E.

### REPORT OF W. G. COMBER, RESIDENT ENGINEER, SIXTH DIVISION.

ISTHMIAN CANAL COMMISSION,  
OFFICE OF THE RESIDENT ENGINEER,  
SIXTH DIVISION, CHIEF ENGINEER'S OFFICE,  
*Balboa, Canal Zone, July 23, 1913.*

SIR: I have the honor to submit the following report of operations in the sixth division during the fiscal year ended June 30, 1913:

#### DIVISION ORGANIZATION.

The division is divided into two districts, the first district embracing all dredging operations south of the Gamboa Bridge and extending to deep water in the Pacific Ocean, the second district all dredging operations north of the Gamboa Bridge and extending to deep water in the Caribbean Sea. Up to the close of the year no dredging had been carried on north of Station 2095 on the Pacific side, or south of the Gatun Locks on the Atlantic side.

#### FIRST DISTRICT.

##### OPERATIONS.

The following dredges were in operation during the year:

	Name.	Type.	Remarks.
1	Culebra.....	Sea-going suction dredge.....	Out of commission 70 days for repairs.
2	Cardenas.....	Five-yard dipper dredge.....	Out of commission 27 days for repairs.
3	Marmot.....	French ladder dredge.....	Out of commission 36 days for repairs.
4	Gopher.....	French ladder dredge (marine).....	Out of commission 18 days for repairs.
5	Badger.....	French ladder dredge.....	Out of commission 43 days for repairs.
6	Mole.....	French ladder dredge (marine).....	Out of commission 10 days for repairs.
7	Corozal.....	Sea-going ladder dredge.....	Out of commission 38 days for repairs.
8	No. 85.....	Pipe-line suction dredge.....	Out of commission 15 days for repairs.

The *Culebra* was engaged throughout the year in deepening the canal channel between stations 2110 and 2510, and maintaining depths in channels to shipways basin, inner harbor, and berths at Panama Railroad docks.

The *Cardenas* was engaged in channel excavation between stations 2175 and 2280, the greater portion of the time being employed in cleaning rock shoals and removing rock broken by the rock breaking equipment; this dredge was also detailed to maintain depths in berths at the Balboa sand dock, and the excavation of channel and berth for material wharf at station 2150.

The *Marmot* operated during entire year in channel excavation between stations 2155 and 2235, dredging time being equally divided between earth and rock removal.

The *Gopher* was engaged during entire year procuring sand for construction purposes.

The *Badger* was employed throughout the year in channel excavation between stations 2146 and 2253, also dredging a portion of the inner harbor and terminal basin at Balboa and assisting in maintenance of berths at Balboa sand dock.

The *Mole* was engaged in channel excavation between stations 2189 and 2270, the greater portion of dredging time being occupied in cleaning rock shoals and removing rock broken by the rock breaking equipment; this dredge was also detailed for relief work at Punta Chame, procuring sand for construction purposes, during overhauling and repair of regular sand dredge.

The *Corozal* operated during the entire year dredging rock and hard clay from the Canal channel between stations 2129 and 2230, removing 680,579 cubic yards of stiff clay and 649,935 cubic yards of rock; 487,451 cubic yards of rock were dredged without having been drilled and blasted.

Dredge No. 85 was put in commission on November 16, 1912, and for remainder of the year was employed dredging material from site of the proposed inner harbor and terminal basin at Balboa.

#### YARDAGE REMOVED.

The following table shows the monthly output of all dredges, exclusive of the sand handling plant:

Month and year.	Canal prism.			Auxiliary.			Grand total.	Unit cost.
	Earth.	Rock.	Total.	Earth.	Rock.	Total.		
1912.	<i>Cubic yards.</i>	<i>Cubic yards.</i>	<i>Cubic yards.</i>	<i>Cubic yards.</i>	<i>Cubic yds.</i>	<i>Cubic yards.</i>	<i>Cubic yards.</i>	
July.....	232,809	74,702	307,511	88,323	3,495	91,818	399,329	\$0.2052
August.....	291,750	74,863	366,613	131,111	.....	131,111	497,724	.1723
September...	275,577	62,145	337,722	16,257	200	16,457	354,179	.3607
October.....	272,862	73,901	346,763	43,132	.....	43,132	389,895	.3532
November...	347,347	101,626	448,973	16,477	.....	16,477	465,450	.2769
December..	250,762	98,985	349,747	191,968	.....	191,968	541,715	.2446
1913.								
January....	122,750	92,275	215,025	216,540	.....	216,540	431,565	.3897
February....	157,776	81,256	239,032	175,225	.....	175,225	414,257	.3754
March.....	297,358	82,487	379,845	166,800	.....	166,800	546,645	.2627
April.....	284,323	72,619	356,942	182,125	.....	182,125	539,067	.2938
May.....	316,103	53,600	369,703	194,510	.....	194,510	564,213	.2627
June.....	424,619	179,461	604,080	31,179	.....	31,179	635,259	.2907
Total...	3,274,036	1,047,920	4,321,956	1,453,647	3,695	1,457,342	5,779,298	.....

At the close of the fiscal year there remained to be removed from the canal prism, south of station 2110, including siltage, 1,847,774 cubic yards of earth and 1,600,000 cubic yards of rock.

#### SUBAQUEOUS ROCK EXCAVATION.

One million forty-seven thousand nine hundred and twenty cubic yards of hard and soft rock were removed from the canal prism during the year. Of this amount 121,161 cubic yards were drilled and blasted by the drill barge *Teredo*, and 65,953 cubic yards broken by the rock breaker *Vulcan*. The remainder includes rock which had



been broken by star drill operations in previous years, and material which could be handled by the dredges without drilling and blasting. Four hundred and eleven thousand nine hundred and eighty-two pounds of dynamite were used on this work during the year.

The following table shows locations of rock shoals worked and monthly statement of volume removed:

Month and year.	Station and method of breaking.		Area covered.	Amount dredged.
	Teredo.	Vulcan.		
1912.			<i>Square feet.</i>	<i>Cubic yards.</i>
July.....	2175, 2270.....	2250, 2250-A.....	44, 515	74, 702
August.....	2175, 2198.....	2250-A, 2200, 2195.....	61, 287	74, 863
September.....	2197, 2198, 2270.....	2192, 2195, 2220.....	61, 839	62, 145
October.....	2260, 2270.....	2195, 2200, 2235.....	58, 775	73, 901
November.....	2260.....	2200.....	76, 764	101, 626
December.....	2176, 2260.....	2200, 2250.....	60, 042	98, 985
1913.				
January.....	2176, 2191, 2192.....	2250.....	63, 194	92, 275
February.....	2192, 2193, 2194.....	2160, 2250.....	43, 597	81, 256
March.....	2194, 2195, 2196, 2191, 2192, 2193.....	2160.....	48, 717	82, 487
April.....	2194, 2195, 2196, 2199, 2200.....	2160.....	87, 108	72, 619
May.....	2199, 2200, 2206, 2198, 2197, 2214, 2215, 2216, 2229, 2230.....	2160, 2185.....	100, 671	53, 600
June.....	2229, 2230, 2224, 2223, 2225, 2248, 2249.....	2185.....	80, 942	179, 461
Total.....			787, 451	1, 047, 920

NOTE.—The above total includes 860,806 cubic yards of rock dredged without drilling and blasting.

On July 1, 1912, 45 feet of water could be carried from station 2510 to station 2290; 42 feet from station 2290 to station 2280; 45 feet from station 2280 to station 2242 plus 882 feet; 42 feet from station 2242 plus 882 feet to station 2185; 35 feet from station 2185 to station 2168; 30 feet from station 2168 to 2147 (dike).

On July 1, 1913, 45 feet of water could be carried from station 2510 to station 2170; 40 feet from station 2170 to station 2147; 35 feet from station 2147 to station 2130; average depth of 27 feet could be carried from station 2130 to station 2115 (dike).

#### BALBOA SHOPS AND SHIPWAYS.

Maintenance repairs were made to all floating plant, shop and yard tools and equipment, and various repair work performed for the Panama Railroad Co., other divisions, departments, and commercial companies.

Pipe-line dredge *No. 85*, which was received, knocked down from the Atlantic division was reassembled at Balboa shops and put into commission in November, 1912.

#### CLEARINGS AND DIVERSIONS.

A force of men has been steadily engaged cutting brush and trees and blasting stumps from dredging site for the inner harbor and terminal basin at Balboa; clearing was extended over an area of 1,050,988 square feet during the year; 25,316 pounds of dynamite was expended on this work.

Seven thousand eight hundred feet of diversion channels were excavated by orange-peel dredge during the year to take care of the drainage of swamp lands at Balboa reclaimed by hydraulic fill.

## MISCELLANEOUS.

Four hundred and fifty-six thousand eight hundred cubic yards of sand were dredged during the year and delivered to various divisions, departments, and outside companies for construction purposes.

One million four hundred and fifty-three thousand six hundred and forty-seven cubic yards of earth and 3,695 cubic yards of rock were removed from inner harbor and terminal basin site; a portion of this excavation was also useful for the maintenance of shipways and lumber-dock channels and berths at sand and repair dock. On July 1, 1913, there remained to be removed from inner harbor and terminal basin site 6,363,240 cubic yards of earth, and 372,062 cubic yards of rock.

## SURVEYS AND MAPPING.

Usual monthly cross sections were taken behind the dredges and yardage estimates prepared; general surveys over entire dredging area were made every four months and progress maps and records prepared; all working ranges and tide gauges were kept up for dredging fleet; surveys and maps made for proposed siphon crossing of canal for handling of pipe-line dredge spoil; relay pump locations; hydraulic dump areas. Surveys and maps made for salvage of sunken steamship *Newport*. Usual routine field work was performed.

## SECOND DISTRICT.

## OPERATIONS.

The following dredges were in operation during the year:

	Name.	Type.	Remarks.
1	Caribbean.....	Sea-going suction dredge.....	Out of commission 51 days for repairs.
2	Charges.....	Five-yard dipper dredge.....	Out of commission 10 days for repairs.
3	Mindi.....	Five-yard dipper dredge.....	Out of commission 79 days for repairs.
4	No. 1.....	French ladder dredge.....	Out of commission 19 days for repairs.
5	No. 5.....	French ladder dredge.....	Out of commission 18 days for repairs.
6	Sandpiper.....	Pipe-line suction dredge.....	Out of commission 104 days for repairs.
7	No. 4.....	Pipe-line suction dredge.....	Out of commission 64 days for repairs.
8	No. 83.....	Pipe-line suction dredge.....	Out of commission — days for repairs.
9	No. 86.....	Pipe-line suction dredge.....	Out of commission 3 days for repairs.

The *Caribbean* was engaged during entire year deepening canal channel between stations 82 and 256, and maintaining depth in channel to Cristobal docks.

The *Charges* operated deepening channel between stations 284 and 334, and excavating for lock wing and guide walls.

Dredge *No. 1* worked entire year deepening channel between stations 186 and 283.

Dredge *No. 5* was engaged during the year in channel excavation between stations 253 and 301.

The *Mindi* was engaged in channel excavation between stations 286 and 322, and dredging at Panama Railroad Piers Nos. 16 and 17, Cristobal.

The *Sandpiper* operated entire period deepening canal channel between stations 243 and 341, and excavating for lock wing and guide walls.

Dredge No. 4 was employed on excavation for lock wing and guide walls, berths at Piers Nos. 16 and 17, and channel excavation between stations 286 and 351.

Dredge No. 86 was employed in channel excavation between stations 162 and 336; also dredging for swamp fill at Margarita Bay.

Dredge No. 83 worked during entire year deepening canal channel between stations 343 and 352 and excavating for lock wing and guide walls.

The following table shows the monthly output of all dredges:

Month and year.	Canal prism.			Auxiliary.			Grand total.	Unit cost.
	Earth.	Rock.	Total.	Earth.	Rock.	Total.		
<b>1912.</b>	<i>Cu. yds.</i>	<i>Cu. yds.</i>	<i>Cu. yds.</i>	<i>Cu. yds.</i>	<i>Cu. yds.</i>	<i>Cu. yds.</i>	<i>Cu. yds.</i>	
July.....	501,780	62,788	564,568	24,321	14,575	38,896	603,464	\$0.2413
August.....	446,816	67,157	513,973	48,552	48,552	97,104	562,525	.2396
September.....	434,264	62,858	497,122	39,183	39,183	78,366	536,305	.2683
October.....	609,671	69,090	678,761	34,248	34,248	68,496	713,009	.2529
November.....	609,480	60,767	670,247	36,432	36,432	72,864	706,679	.1839
December.....	746,285	68,088	814,373	27,070	16,294	43,364	857,737	.1639
<b>1913.</b>								
January.....	467,720	40,618	508,338	318,041	.....	318,041	826,379	.1710
February.....	250,491	53,458	303,949	248,873	.....	248,873	552,822	.2265
March.....	329,077	51,166	380,243	277,833	.....	277,833	658,076	.1754
April.....	377,739	58,866	436,605	52,190	.....	52,190	488,795	.2685
May.....	563,173	121,990	685,163	272,726	.....	272,726	957,889	.1436
June.....	722,785	91,807	814,592	.....	.....	.....	814,592	.2123
<b>Total.....</b>	<b>6,059,281</b>	<b>808,653</b>	<b>6,867,934</b>	<b>1,221,054</b>	<b>189,284</b>	<b>1,410,338</b>	<b>8,278,272</b>	<b>.....</b>

#### DREDGING, OCEAN TO GATUN LOCKS.

*Harbor and channel section.*—5,634,122 cubic yards of earth and 768,051 cubic yards of rock were removed from the canal prism during the year: On July 1, 1913, there remained to be removed from the prism 1,837,000 cubic yards of earth and 99,600 cubic yards of rock.

*Gatun Locks section.*—425,159 cubic yards of earth and 40,602 cubic yards of rock were dredged from the chamber for lock wing and guide walls during the year.

#### SUBAQUEOUS ROCK EXCAVATION.

During the year the drill boat *Terrier* drilled 43,062 linear feet in the prism, breaking a total of 394,526 cubic yards of material; 4,511 feet were drilled and 34,448 cubic yards of material broken at site of permanent bridge across the French Canal to connect with the coaling plant on Telfer Island; 357,785 pounds of dynamite were used on this work.

#### CRISTOBAL TERMINALS.

One hundred and fifty-five thousand six hundred and ninety three cubic yards of earth and 189,284 cubic yards of coral rock were removed from the slip between Piers 16 and 17 of the new terminals during the year, in addition to 665,018 cubic yards of earth from the approach channel.

## MISCELLANEOUS.

On July 1, 1912, 40 feet of water could be carried from MP-0 to MP-0 plus 2,200 feet; 37 feet to MP-1 plus 4,200 feet; 35 feet to MP-4 plus 3,050 feet; 30 feet to MP-4 plus 3,150 feet; 25 feet to MP-5 plus 5,100 feet; 20 feet to MP-5 plus 5,200 feet.

On July 1, 1913, 40 feet of water could be carried from MP-0 to MP-0 plus 2,100 feet; 35 feet to MP-6 plus 2,300 feet; 30 feet to MP-6 plus 2,320 feet; 20 feet to MP-6 plus 2,350 feet; 10 feet to MP-6 plus 2,800 feet.

The siltage in the canal prism for the year amounted to 2,084,000 cubic yards.

Three thousand eight hundred and fifty-one cubic yards of earth were removed from the dry-dock basin to provide mooring berth for the suction dredge *Caribbean*; 295,535 cubic yards of earth from the French Canal at Mindi; 100,957 cubic yards of earth were dredged from Margarita Bay and used for parapet and swamp fill at that point.

A site was cleared for proposed coaling station on Telfer Island.

Six hundred and eighty thousand one hundred and seventy-six cubic yards of rock were dumped in the vicinity of the west breakwater during the year, making a total to date of 1,810,108 cubic yards; of this amount 651,000 cubic yards were dumped within the breakwater section proper.

One hundred and sixty-seven borings were taken under the wing and guide walls of Gatun Locks.

## SURVEYS AND MAPPING.

Surveys and charts were made of the French Canal, approach channel, and berths at Piers 16 and 17 of the new terminal layout; a survey and chart was made of Limon Bay between the canal prism and the west shore, and Sweetwater and the west breakwater; a scour survey was made around the south shore of Limon Bay. Usual routine fieldwork was performed in connection with the dredging operations and progress maps and records prepared.

## OFFICE.

Routine clerical work, preparation of progress records, estimates, requisitions, etc., was satisfactorily performed during the year.

Dredge excavation.	Unit.	Amount.
In prism.....	Cubic yards....	11, 189, 880
Auxiliary.....	.....do.....	2, 867, 680
Total.....	.....do.....	14, 057, 560
Explosives used.....	Tons.....	355
Cement used.....	Barrels.....	413
Rock drilled (submarine).....	Feet.....	178, 350

Respectfully submitted.

W. G. COMBER,  
Resident Engineer.

Col. GEO. W. GOETHALS, U. S. Army,  
Chairman and Chief Engineer, Culebra, Canal Zone.

## APPENDIX F

### REPORT OF CIVIL ENGINEER H. H. ROUSSEAU, UNITED STATES NAVY, MEMBER OF ISTHMIAN CANAL COMMISSION, ASSIST- ANT TO THE CHIEF ENGINEER, IN CHARGE OF THE SECOND DIVISION OF THE OFFICE OF THE CHIEF ENGINEER.

#### ISTHMIAN CANAL COMMISSION, OFFICE OF THE CHIEF ENGINEER, SECOND DIVISION, *Culebra, Canal Zone, August 15, 1913.*

SIR: I have the honor to submit the following report for the second division of the office of the chief engineer for the fiscal year ended June 30, 1913.

The total specific appropriations by Congress available to June 30, 1913, not including fortifications or private claims, amounted to \$322,541,468.58, or 86 per cent of the total estimate of December, 1908, of \$375,201,000. By act approved June 23, 1913, additional appropriations were made for the fiscal year 1914 amounting to \$16,265,393, exclusive of fortifications, leaving \$36,394,138.42 of the total estimated cost of the canal to be appropriated hereafter, or 9.7 per cent.

To June 30, 1913, the classified expenditures, i. e., expenditures under general account No. 1 which have been charged into the work, amounted to \$295,871,455.38, or about 79 per cent of the total estimated cost. Of this amount \$36,218,218.64 were expended during the fiscal year 1913, or about 9.7 per cent of the total estimated cost of the canal. The difference between the appropriations available to June 30, 1913, and the classified expenditures to June 30, 1913, amounting to \$26,670,013.20, represents such items as unexpended balances of appropriations, unexpended material and supplies in storehouse, and other items reported as "Unclassified expenditures," under general accounts other than general account No. 1, which are not yet properly chargeable against construction work. They are listed in Table No. 2 of the examiner of accounts annual report.

The quantity of work performed to June 30, 1913, for the three principal items of excavation, concrete, and fill in dams, the total quantity to be performed, and the amount performed during the year 1913 are as follows:

Item of work.	Estimated total quantity as of July 1, 1913.	Completed to June 30, 1913.		Performed during fiscal year 1913.	
		Quantity.	Per cent of total.	Quantity.	Per cent of total.
Excavation:	<i>Cubic yards.</i>	<i>Cubic yards.</i>		<i>Cubic yards.</i>	
Dry.....	134,795,000	125,207,928	92.89	16,978,077	12.60
Wet.....	97,558,000	78,175,611	80.13	13,135,647	13.47
Total.....	232,353,000	203,383,539	87.53	30,113,724	12.96
Concrete.....	5,208,800	4,786,253	91.89	827,609	15.89
Fill in dams.....	25,858,000	25,617,523	99.07	2,556,363	9.89

The accompanying chart (plate No. 103) shows graphically the excavation, concrete, and fill and the total expenditures to June 30, 1913, together with the monthly rate of progress of the work and expenditures.

Of the total classified expenditures to June 30, 1913, \$33,108,132.37 or about 11 per cent, was for plant and equipment for construction and for the purchase of four steamships, of which amount \$560,438.62 was expended during the fiscal year 1913.

### TERMINALS.

*General.*—Act of Congress approved June 28, 1902, authorizing the construction of the canal, called the Spooner Act, directed the President to “also construct such safe and commodious harbors at the termini of the said canal as shall be necessary for the safe and convenient use thereof.” The estimate of December, 1908, of the cost of the canal, of \$375,201,000 therefore made provision for the construction of the necessary breakwaters, but did not include anything for such harbor improvements as may be classed as “terminal facilities.” Terminal facilities on the Isthmus have been provided and operated heretofore by the Panama Railroad Co. in connection with the handling of its commercial and other business. It was early seen that the canal would require terminal facilities of greater extent than the Panama Railroad Co. would be warranted or able to furnish solely to meet its own requirements. It has also been apparent for several years that the savings accomplished in construction work, as compared with the estimate of December, 1908, would enable the commission to provide at its own expense the greater part of these facilities without exceeding the estimated cost of the canal. In last year’s annual report the general characteristics of the terminal facilities proposed were described, and the necessary authority for their construction was granted by act of Congress approved August 24, 1912, known as the “Panama Canal act,” authorizing the President to “establish, maintain, and operate, through the Panama Railroad or otherwise, dry docks, repair shops, yards, docks, wharves, warehouses, storehouses, and other necessary facilities for the purpose of providing coal and other materials, labor, repairs, and supplies for vessels of the Government of the United States, and incidentally for supplying such at a reasonable price to passing vessels.” The sundry civil bill, also approved August 24, 1912, making appropriations for the fiscal year ended June 30, 1913, made available the necessary sums to undertake terminal construction.

*Pacific terminals.*—The Pacific, or Balboa, terminals include the permanent shops and auxiliary buildings; the main dry dock, No. 1, and one subsidiary dry dock, No. 2; a subsidiary plant for supplying coal and fuel oil to vessels; the necessary wharves and piers for repair purposes, as well as for commercial use. The construction of a new freight yard in connection with the relocation of the Panama Railroad permanent main line from Diablo to Panama via Balboa and the new docks and wharves will also be necessary. It has been proposed that

all of this work be paid for from canal appropriations, except such track work, etc., in connection with the new freight yard and tracks for the Panama Railroad as will be borne by the latter.

Grouped around the Pacific terminals, and conveniently located with reference thereto, will be the permanent Pacific settlements for the gold and silver employees and the general administration building.

*Atlantic terminals.*—So far as projected to date these consist principally of the necessary permanent wharves and piers in Cristobal, including the Cristobal mole and additional yard tracks, which are being constructed by the Panama Railroad at its own expense, and the main plant for supplying coal and fuel oil to vessels. The fuel-oil facilities are being furnished by the commission. It is proposed that the cost of the main coaling plant shall be divided between the commission and the Panama Railroad Co.

#### CONSTRUCTION—PACIFIC TERMINALS.

Up to December 12, 1912, construction work on Pacific terminal facilities was under the Pacific division. Upon the resignation of Mr. S. B. Williamson, division engineer, on that date, this construction work, not including dredging, was transferred to this office and has since been carried on thereunder. From August 1, 1912, Mr. H. D. Hinman has been in local charge as assistant engineer. The work accomplished during the year has been as follows:

*Clearing site.*—This involved the removal of the commission settlement at Balboa, as well as the buildings which formed the old town of La Boca, and the abandonment of the Panama Railroad yard. A considerable quantity of old scrap iron and spare parts for floating equipment had to be removed to new locations. Certain old tracks of the Panama Railroad were taken up and new yard and track facilities furnished for temporary use until the permanent yards and tracks can be built on the area which is being filled in the rear of the permanent piers. Considerable difficulty has been experienced in carrying on construction work expeditiously and economically in this whole area without causing serious inconvenience to other divisions and departments whose work and operations could not be interrupted, and the cost of construction work to this division has been unavoidably increased thereby by an appreciable amount.

*Relocation of highway and main tracks to old French Pier.*—One hundred and eighty-four thousand six hundred and eighty-two cubic yards of rock, 181,729 cubic yards of earth, a total of 366,411 cubic yards, were removed from the northwest slope of Sosa Hill to obtain room around the head of Dry Dock No. 1 for crane and railroad tracks and the highway leading to the old French pier. The greater part of this material was used to fill in the adjacent swamp to bring this area up to yard grade; some of the rock was furnished the Atlantic division

for use in paving the south slope of Gatun Dam. This excavation, by months is contained in the following table, No. 1:

TABLE NO. 1.

Month.	Material excavated (cubic yards).		
	Earth.	Rock.	Total.
1912.			
July.....	53,354	6,860	60,214
August.....	44,854	12,140	56,994
September.....	20,670	26,150	46,820
October.....	10,137	34,113	44,250
November.....	10,761	23,577	34,338
December.....	4,512	15,258	19,770
1913.			
January.....	14,458	3,615	18,073
February.....	3,526	8,298	11,824
March.....	730	17,534	18,264
April.....	1,463	16,151	17,614
May.....	3,280	13,120	16,400
June.....	13,984	7,866	21,850
Total.....	181,729	184,682	366,411

*Dry Dock No. 1, entrance basin, and coaling plant.*—No other work than clearing the site and excavation has been carried on during the year. Panama Railroad and other yard tracks were removed from the site and the relocated line around the toe of Sosa Hill was ready for operation on November 1, 1912. Lack of locomotives and cars prevented excavation from starting until December 27, when one large shovel was started on the site of the coaling plant to work northeast over the entrance basin and dry dock site. On account of the cramped working space and the condition of the ground the incline leading out of the dry dock was located at its head. The original surface elevation of the dry dock site averaged +18, the deepest general excavation for the foundation will be about -56; the lowest shovel cut on June 30, 1913, was -12, on the coaling plant site at the southwest end of the excavation. No trouble has been experienced in keeping the excavated pit dry.

Fifty-six thousand nine hundred cubic yards of rock and 146,799 cubic yards of earth were removed during the year. Rock, a fine-grained andesite, lies comparatively near the surface of the dry dock site. It is the intention to shoot the rock from the sides of the excavation with such care as will carry the solid rock walls as vertical and unbroken as possible. Monthly excavation figures for Dry Dock No. 1, entrance basin, and coaling plant are given in the following table, No. 2:



TABLE NO. 2.

Month.	Material excavated—cubic yards.		
	Earth.	Rock.	Total.
1913.			
Dry Dock No. 1:			
January.....	8,342	5,017	13,359
February.....	2,900	.....	2,900
March.....	8,850	12,313	21,163
April.....	6,223	12,243	18,466
May.....	9,156	8,817	17,973
June.....	18,703	16,129	34,832
Total.....	54,174	54,519	108,693
Entrance basin:			
January.....	6,905	.....	6,905
February.....	8,829	.....	8,829
March.....	1,873	881	2,754
April.....	5,696	.....	5,696
May.....	1,391	.....	1,391
June.....	9,710	1,500	11,210
Total.....	34,404	2,381	36,785
Dry-dock incline:			
February.....	3,210	.....	3,210
March.....	2,764	1,185	3,949
May.....	13,076	.....	13,076
Total.....	19,050	1,185	20,235
1912.			
Coaling basin:			
December.....	3,751	.....	3,751
1913.			
January.....	9,245	.....	9,245
February.....	3,843	.....	3,843
March.....	555	.....	555
April.....	6,621	.....	6,621
May.....	6,790	.....	6,790
June.....	27,416	.....	27,416
Total.....	58,221	.....	58,221
Grand total.....	165,849	58,085	223,934

The performance of steam shovels, by months, is given in the following table, No. 2a:

TABLE NO. 2a.

Month.	Average number of shovels working.	Hours under steam.	Hours working.	Earth.	Rock.	Total.	Average per hour under steam.	Rainfall.
1912.								Inches.
July.....	1.81	376.00	131.17	51,430	6,860	58,290	155.00	9.76
August.....	1.96	424.00	154.58	44,854	12,140	56,994	134.42	6.79
September.....	2.04	392.00	240.50	20,670	26,150	46,820	119.44	10.01
October.....	1.96	416.00	259.58	9,639	35,763	45,402	109.14	15.75
November.....	1.95	500.00	267.00	10,104	23,577	33,681	67.36	6.14
December.....	2.08	408.00	196.50	8,494	15,258	23,752	58.21	4.94
1913.								
January.....	2.15	441.25	251.67	41,560	8,632	50,192	113.75	.78
February.....	2.50	456.00	229.58	23,083	8,298	31,381	68.82	.19
March.....	2.34	649.91	268.17	16,636	31,913	47,549	73.16	.....
April.....	3.92	784.00	368.98	31,868	28,394	60,262	76.86	.06
May.....	4.03	852.33	394.16	37,413	22,217	59,630	69.96	8.04
June.....	4.56	912.00	428.00	69,813	25,495	95,308	104.50	7.15
Total.....	2.61	6,611.49	3,189.89	364,564	244,697	609,261	105.36	69.61

*Auxiliary Dry Dock No. 2.*—This dock is for the use of smaller vessels. It will be founded on rock and its construction will be undertaken in conjunction with main Dry Dock No. 1. The site of this dock has been occupied during the year by the shipways and certain shops of the sixth division that can not be abandoned until other repair facilities for floating equipment are available elsewhere. This site will also have to be cofferdammed before any considerable amount of excavation can be performed; for these reasons no work has been possible during the year.

*Cofferdam.*—To protect the entrance of Dry Dock No. 1, and the entire area to be occupied by Dry Dock No. 2, and to enable as much rock in the dry-dock entrance basin as possible to be removed in the dry, as well as to facilitate the construction of the coaling plant quay wall and the basin for storage of coal, a cofferdam composed of clay ripped with rock will be constructed around the foregoing works. Work on this cofferdam started on April 1, 1913, and its construction has necessitated a rearrangement of the Panama Railroad tracks leading to the new concrete wharf, the fifth division sand service tracks, and tracks used by the sixth division and quartermaster's department. Eighty feet of the sand bins were removed. The cofferdam, when completed, will be about 1,000 feet in length.

*Quay walls and Pier No. 1.*—This includes a 1,238-foot length of quay wall between the head of Slip No. 1 and the northeast end of the new Panama Railroad concrete dock; Pier No. 1, 1,000 feet long by 201 feet wide; and 606 feet of permanent wall at the head of Slips Nos. 1 and 2, of which about 484 feet will be constructed as a landing for small boats, making a total water frontage of about 4,045 feet. The quay walls and all of Pier No. 1 excepting a center section of 50 feet wide will be supported on circular reenforced concrete piers sunk to rock. The 50-foot center section of Pier No. 1 will consist of a rock fill. Dredging will be carried to -45 alongside of all wharves and piers. The level of Pier No. 1 and the adjoining wharves at the head of the slips has been fixed at +16.5. The level of the quay wall adjoining the Panama Railroad dock has been fixed at +17, the same level as the Panama Railroad dock.

Over this entire area rock is found at an average elevation of about -60, in a few cases being as high as -33 and in other cases being as deep as -66. The average level of the original swamp was about +9 and the material through which the concrete cylinders are being sunk is a fine, sticky, black clay, in which are found thin strata of sand. The cylinders are being sunk by the open caisson method; intermediate sections consist of a reenforced concrete shell 1 foot thick,  $7\frac{1}{2}$  feet outside diameter, in 6-foot lengths; about 4,750 sections are required and a special plant for their manufacture has been built. Steel collapsible forms are used. The bottom section of each cylinder is 8 feet in outside diameter and 6 inches thick, with a cutting shoe on the bottom. Excavation was performed by hand and by orange-peel buckets. When the cylinders would not sink through the excavation by their own weight, their descent was facilitated by the use of cast-iron and concrete weights in conjunction with a water jet. The progress of sinking the cylinders has depended upon the crane service available. The cylinders are sunk several feet into rock before being filled with concrete. The construction of the dike necessary to inclose the area occupied by the quay walls and pier so

that they can be constructed in the dry was started in July, 1912. The placing of the concrete cylinders began in October, 1912. The estimated number of linear feet of concrete cylinder required for this work is 28,500, of which 12,435 feet was placed during the year. Of this amount 8,450 feet was for the main quay wall, 289 feet for the walls at the head of Slips Nos. 1 and 2, and 3,696 for Pier No. 1.

The following table, No. 3, shows the progress of caisson sinking during the year:

TABLE No. 3.

Month.	Penetration (linear feet).				Number of caissons sunk to rock.		
	Quay wall "ghi."	Pier No. 1.	Bulk- head.	Total.	Quay wall "ghi."	Pier No. 1.	Total.
1912.							
October.....	229	.....	.....	229	.....	.....	.....
November.....	606	.....	.....	606	.....	.....	.....
December.....	970	.....	.....	970	.....	.....	.....
1913.							
January.....	1,267	.....	.....	1,267	4	.....	4
February.....	846	260	.....	1,106	15	.....	15
March.....	620	1,298	.....	1,918	22	.....	22
April.....	1,528	634	.....	2,162	21	8	29
May.....	1,343	532	.....	1,875	26	5	31
June.....	1,041	972	289	2,302	27	12	39
Total.....	8,450	3,696	289	12,435	115	25	140

Plate No. 104 accompanying this report shows graphically progress in manufacture and sinking caissons to July 1, 1913. Plates Nos. 105, 106, and 107, accompanying this report show details of the forms used in casting the concrete cylinders, and also show the layout of the plant required for their manufacture.

*Permanent shops—Clearing site.*—Work of clearing site began in August, 1912, and included the removal of Panama Railroad tracks and commission construction tracks, making a new connection to the Panama Railroad concrete dock, removing several small buildings, and material stored in the open under the quartermaster's department and the removal to another site of the blacksmith shop and several other smaller shops of the sixth division.

*Fill.*—During the year the greater portion of the area occupied by the shops was brought up to grade by filling the low swampy bottom with material made available by excavating operations.

*Foundations.*—It was desired to found buildings on the natural soil, the load being transmitted directly to the concrete footings from the steel columns, in order to avoid the expense of either supporting the piers on piles driven to hard bottom, or of carrying the concrete footing down to rock where the depths to same was not excessive. Full size tests of the bearing power of the natural soil showed that this would not be generally satisfactory except for the smaller buildings, where the unit loads could be made insignificant. When rock was not lower than about +1 it was found practicable and most economical to excavate down to rock and build the concrete piers thereon. Where hard bottom was lower than about +1 wooden piles were ordered and driven down to rock, which in some places

was as low as -56. These wooden piles were cut off below the level of ground water and concrete piers built up therefrom; the general elevation of the top of piers is +17. Where the conditions were not favorable to carry the excavation down to the level of ground water, reenforced concrete piles were used. To meet the special conditions found at the water front, under the machine shop and the crane runway extension of the forge shop, it was necessary to use 4-foot steel cylinders filled with concrete after being sunk to rock as foundations for 29 columns.

Table No. 4, following, gives a record by months of piles driven and the concrete placed in the foundation of each building:

TABLE No. 4.  
NUMBER OF PILES DRIVEN.

Shop building No.	1912		1913							Total.
	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	
1.....						214				214
2.....						68	43	9		120
3.....						67	75	9		151
4.....						382	161			543
5.....		117	162	295	654	137	290			1,655
6.....	77	68								145
7.....							3	177		180
8.....										
9.....				13						13
10.....	144			162						306
11.....						24				24
12.....				72	53	206				331
13.....										
14.....										
15 <sup>1</sup> .....								43	25	68
Total.....	221	185	162	542	707	1,098	572	238	25	3,750

<sup>1</sup> Concrete piles.

CONCRETE IN SHOP-BUILDING FOOTINGS (CUBIC YARDS).

1.....					14	110	212	305	63	704
2.....					3	48	64	12	221	348
3.....						28	92	166	64	350
4.....				27	10	7		517	62	623
5.....							1,360	257	60	1,677
6.....			135	232			10			377
7.....								27	8	35
8.....		153	115		6					268
9.....				82	6		19			107
10.....	244	167		100	235		25			771
11.....						108				108
12.....						850	2			852
13.....					14	22				36
14.....										
15.....										
16.....									11	11
Total.....	244	320	250	441	282	1,173	1,784	1,284	489	6,267

*Operating tunnel.*—Work on the reenforced concrete operating tunnel running at right angles to the length of the main shop buildings through their center, for carrying and making accessible all pipe and cable conduits, has been carried on as fast as practicable; the necessary excavation was performed by a steam shovel, mounted on skids, with a special boom. This shovel commenced work on March 20, 1913. Where hard rock is not deeper than about mean sea level the

tunnel has been built on piers excavated to rock; at all other points the tunnel is carried on wooden piles driven to rock and cut off below the mean elevation of ground water. The tunnel is being built in sections 15 feet in length; special means have been taken to make the tunnel as water-tight as practicable by care in the mixing and placing of concrete, by coating the exterior of the tunnel with two coats of alum solution, and by making water-tight joints between the adjacent sections by means of 5-inch strips of 26-gauge Muntz metal, half of each strip being built into each adjacent section.

*Foundations for shop tools, machinery, etc.*—Work was started on June 5, 1913, in building No. 8, planing mill, on the foundations for the machines. During June the excavation for the concrete floor for building No. 8 was made, and a considerable portion of the concrete base was placed.

*Inner harbor excavation.*—This excavation was performed by the dredges of the sixth division. A large part of the material was pumped into the low swamp land north and east of Sosa Hill.

*Tracks.*—One hundred and thirty-three thousand two hundred and forty-six linear feet, or a little more than 25 miles, of track were laid during the year. Of this amount 9,212 feet were permanent tracks and the remainder was for construction work.

*Highway and ditches.*—Three thousand three hundred linear feet of highway was built at the foot of Sosa Hill to replace that destroyed by dry-dock excavation. Twenty-five thousand nine hundred and ninety-one linear feet of ditches were dug during the year.

*General.*—Tables Nos. 5 to 10, inclusive, herewith, show details of work accomplished during the year, by months:

TABLE NO. 5.—Statement of work done, Balboa terminals, July 1, 1912, to June 30, 1913.

Month.	Excavation (cubic yards).											Total.	
	Preparing site.			Dry Dock No. 1, coal- ing basin, entrance.		Shop founda- tions.		Shops tunnel.		Sinking wharf piers.			
	Steam shovel.	Hand.											
				Steam shovel.	In- cline.								
	Earth.	Rock.	Earth.	Earth.	Rock.								Steam shovel.
1912.													
July.....	51,430	6,860	8,780	.....	.....	.....	.....	.....	.....	.....	.....	67,070	
August.....	44,854	12,140	7,969	.....	.....	.....	.....	.....	.....	.....	.....	64,963	
September.....	20,670	26,150	3,918	.....	.....	.....	.....	.....	.....	.....	.....	50,738	
October.....	9,639	35,763	2,727	.....	.....	.....	626	.....	.....	.....	426	49,181	
November.....	10,104	23,577	657	.....	.....	.....	497	.....	.....	.....	1,081	36,041	
December.....	3,993	15,258	1,053	3,751	.....	750	853	.....	.....	.....	1,940	27,598	
1913.													
January.....	14,458	3,615	53	24,492	5,017	2,610	1,388	.....	.....	2,300	234	54,167	
February.....	2,341	8,298	1,185	18,782	.....	1,960	1,174	.....	.....	1,873	340	35,953	
March.....	730	17,534	.....	14,042	14,379	.....	3,951	864	.....	2,212	1,624	55,336	
April.....	1,463	16,151	.....	18,540	12,243	2,600	3,487	9,265	222	3,769	556	68,296	
May.....	3,280	13,120	.....	30,413	8,817	.....	2,640	.....	270	4,000	3,297	66,291	
June.....	13,984	7,866	.....	55,829	17,629	.....	1,005	.....	75	.....	4,062	100,991	
Total.....	176,946	186,332	26,342	165,849	58,085	7,920	15,621	10,129	567	4,000	20,960	3,874	676,625

TABLE NO. 6.—Statement of work done, Balboa terminals, July 1, 1912, to June 30, 1913.

Month.	Drilling (linear feet).			Dynamite (gross tons).
	Tripod drills.	Well drills.	Total.	
1912.				
July.....	8, 196		8, 196	.....
August.....	8, 521	1, 149	9, 670	4. 46
September.....	8, 786	619	9, 405	15. 22
October.....	9, 568		9, 568	16. 27
November.....	9, 192		9, 192	4. 46
December.....	6, 676		6, 676	10. 28
1913.				
January.....	13, 856		13, 856	7. 43
February.....	11, 939		11, 939	7. 97
March.....	12, 698		12, 698	11. 96
April.....	15, 440		15, 440	10. 03
May.....	30, 196		30, 196	10. 21
June.....	29, 750		29, 750	11. 30
Total.....	164, 818	1, 768	166, 586	109. 59

TABLE NO. 7.—Statement of work done, Balboa terminals, July 1, 1912, to June 30, 1913.

Month.	Filling and embankment (cubic yards).					
	Preparing site.	Yards and tracks.	Backfill.		Dikes, plant.	Total.
			Shops.	Tunnel.		
1912.						
July .....	64,860					64,860
August.....	37,770	5,683			11,527	54,980
September.....	37,704	10,503				48,207
October.....	41,847					41,847
November.....	27,861	3,457			1,206	32,524
December.....	27,803	11,450				39,253
1913.						
January.....	34,575	6,274			7,871	48,720
February.....	32,274	1,796			7,767	41,837
March.....	33,384	120			9,086	42,590
April.....	37,263		1,405		10,400	49,068
May.....	35,430	2,063	1,058	120	10,421	49,092
June.....	71,508	1,310	1,755	275	15,620	90,468
Total .....	482,279	42,656	4,218	395	73,898	603,446

TABLE No. 8.—Statement of work done, Balboa terminals, July 1, 1912, to June 30, 1913.

Month.	Reenforcing steel (pounds).				Fixed steel (pounds).		
	Caissons (shells and filler).	Tunnel.	Shops.	Total.	Tunnel.	Shops.	Total.
1912.							
July.....							
August.....							
September.....							
October.....	51,299			51,299			
November.....	57,140			57,140		716	716
December.....	92,148			92,148		1,913	1,913
1913.							
January.....	124,196		454	124,650		454	454
February.....	195,838		590	196,428		1,120	1,120
March.....	180,074		20,671	200,745		8,408	8,408
April.....	430,796	7,190	10,350	448,336		13,238	13,238
May.....	501,069	52,240	10,500	563,809		8,187	8,187
June.....	<sup>2</sup> 411,514	33,387	<sup>3</sup> 7,265	452,166	3,840	<sup>4</sup> 25,844	29,724
Total.....	2,044,074	92,817	49,830	2,186,721	3,840	59,920	63,760

<sup>1</sup> Machine footings, 7,360 pounds.<sup>2</sup> Beams and girders, 112,778 pounds.<sup>3</sup> Machine footings, 2,529 pounds.<sup>4</sup> 4-foot cylinders in building No. 1, 34,500 pounds.

TABLE No. 9.—Statement of work done, Balboa terminals, July 1, 1912, to June 30, 1913.

Month.	Concrete (cubic yards).						
	Caissons.		Piers.	Shops.		Tunnel.	Sosa Hill.
	Shells.	Filler.		Beams.	Machine footings and floor.		
1912.							
October.....	212		244				456
November.....	292		320				612
December.....	817		251				1,068
1913.							
January.....	1,193		442				1,635
February.....	1,277	85	282				1,644
March.....	1,299	232	1,173				2,704
April.....	1,578	1,012	1,784		111	185	4,829
May.....	1,189	1,351	1,284		30	533	4,534
June.....	1,589	1,234	489	37	164	765	4,340
Total.....	9,446	3,914	6,269	37	305	1,483	21,822

NOTE.—Eleven cubic yards placed in test piers not included in the above.

TABLE NO. 10.—*Statement of work done, Balboa terminals, July 1, 1912, to June 30, 1913.*

Month.	Construction tracks.		Shops.	Piles.		Ditches dug.
	Laid.	Re-moved.		Trestles.	Tunnel.	
1912.	<i>Linear ft.</i>	<i>Linear ft.</i>	<i>Number.</i>	<i>Number.</i>	<i>Number.</i>	<i>Linear ft.</i>
July.....	10, 264	.....	.....	.....	.....	.....
August.....	4, 483	.....	.....	.....	.....	.....
September.....	3, 462	.....	.....	.....	.....	300
October.....	3, 800	.....	221	23	.....	500
November.....	6, 192	.....	185	.....	.....	.....
December.....	10, 438	.....	162	.....	.....	1, 900
1913.						
January.....	7, 976	.....	542	74	.....	2, 804
February.....	9, 404	.....	707	2	.....	4, 625
March.....	18, 519	14, 102	1, 098	.....	.....	900
April.....	16, 696	6, 480	572	103	.....	8, 012
May.....	12, 293	9, 752	238	400	177	3, 700
June.....	20, 709	5, 307	25	471	172	3, 250
Total.....	124, 236	35, 641	3, 750	1, 073	349	25, 991

*Contract work.*—In addition to work performed by commission forces, other construction work performed by contractors includes the following:

The steel framework for the shop buildings amounting to about 6,000 tons is being furnished and erected by the United States Steel Products Co.; award was made on October 22, 1912, at 3.6 cents per pound for the 16 main buildings. The contract required erection to be started May 15 and to be completed by October 8, 1913. A supplemental order was given January 25, 1913, for the steel for nine toilet buildings and one paint house, buildings Nos. 17 to 26. This contractor is also furnishing the framework for the sand house, building No. 27, and the structural steel for shafting supports in building No. 1. The rolling of the steel began the last week in February and the first shipment, of 227 tons, left Baltimore on March 30. On June 30 the status of the work was as follows:

	Per cent.
Rolled, in mills.....	100
Finished, in shops.....	66.5
Shipped to tidewater.....	56.5
Shipped to Isthmus.....	43

Contract required that all material shall be given one coat of red lead in shops and two coats white lead after erection. The following is a list of the buildings and their floor areas that have been authorized to date:



Building No.	Shop.	Floor area.
		<i>Square feet.</i>
1.	Machine, erecting, and tool shops.....	67,420
2.	Forge shop.....	31,650
3.	Steel storage shed.....	18,080
4.	Boiler and shipfitter shop.....	45,940
5.	General storehouse.....	89,920
6.	Paint shop.....	12,760
7.	Car shop.....	38,800
8.	Planing mill.....	48,240
9.	Galvanizing plant.....	5,620
10.	Lumber and equipment shed.....	67,180
11.	Pattern storage.....	6,960
12.	Foundry.....	37,060
13.	Coke shed.....	3,070
14.	Boiler house.....	2,380
15.	Roundhouse.....	25,343
16.	Gas house.....	649
17.	Toilet building, gold employees.....	1,057
18.	.....do.....	1,057
19.	Toilet building, silver employees.....	699
20.	.....do.....	699
21.	Toilet building, gold and silver employees.....	1,755
22.	.....do.....	1,755
23.	.....do.....	1,755
24.	.....do.....	1,039
25.	.....do.....	1,039
26.	Paint house.....	1,157
27.	Sand house.....	498
28.	Office.....	26,148
	Total.....	539,830

*Roofing.*—A contract was made on October 24, 1912, with the American Cement Tile Manufacturing Co., of Pittsburgh, Pa., for 6,500 squares, more or less, of reenforced cement tile roofing for all quarter-pitched roofs of the shop buildings at \$10.25 per square delivered, and \$13.25 per square erected in place, based on certain materials, such as sand and cement, and certain facilities, such as use of suitable building, power, water, etc., being furnished by the commission without charge. All tile is being manufactured on the Isthmus at Paraiso. The contract required all plant to be on the Isthmus by January 25, 1913, and for the completion of manufacture by June 25, 1913. At the close of the fiscal year 49.12 per cent of the tile had been manufactured and 7.9 per cent had been laid.

#### CONSTRUCTION—ATLANTIC TERMINALS.

*Wharves, piers, and dredging.*—All work under this heading, except dredging, has been performed by the Panama Railroad Co. Dredging was done by the Atlantic division.

*Main coaling plant.*—On request of the commission, the Panama Railroad Co. has made diamond-drill borings at the site of the coaling pier and submitted data thereon. Work was started by the sixth division in June, 1913, on drilling and blasting preparatory to dredging alongside the proposed coaling pier.

#### OFFICE WORK—TERMINALS.

*Permanent shops.*—Designing work in connection with the permanent shops and the inspection of erection of the steel work and roofing has been under the immediate direction of Lieut. Col. T. C. Dickson, Ordnance Department, United States Army, inspector of shops, and at the end of the year the force of engineers, draftsmen, and assist-

ants numbered 18. During the year, 212 drawings were completed, including 41 drawings, showing motorizing of machines.

Before this force was organized the structural steel drawings and specifications had been prepared under the immediate direction of Assistant Engineer G. I. Finley, who, upon the award of contract, went to the States, where he remained until 463 working drawings and 278 bills of material for the steelwork had been checked and approved. The designing work accomplished and the tracings which had been approved during the year include foundations, walls, windows, doors, steel rolling doors, movable and fixed louvers, etc., for inclosing the buildings; the floor plans of the shops office building; roof drainage system; piping system for water, steam, compressed air, fuel oil, and sewerage; layout of conduits, etc., for electric power and lighting systems; foundations for machines, etc.; details for applying motors to machines; stringers, shafting, etc., for groups of machines driven by motors; work benches and tables; wire-screen partitions for offices and tool rooms; engine pits and transfer table; racks for patterns; illumination system; distribution of power to motors and location of control apparatus.

*General description.*—The principle aimed at in the design of the permanent shops has been to reduce to a minimum the cost of repairs and renewals, without exceeding a reasonable first cost. To attain this steel was adopted for the main structural material, for which the only cost for maintenance will be repainting from time to time. There is less humidity at Balboa than elsewhere on the Isthmus. The roofing, consisting of reenforced cement tile on the quarter-pitched roofs, should last indefinitely with practically no cost for maintenance and repairs, and presents a pleasing appearance. Such buildings as have a flat reenforced concrete roof will be waterproofed with first quality composition roofing. There will be practically no gutters or down spouts, except for drainage of valleys, in which cases copper and similar permanent construction will be employed. California redwood, which has high resisting powers to decay and is immune to attacks of white ants, is being used for all millwork.

Buildings that require it will be closed in with walls of hollow terracotta tile plastered with cement mortar; other buildings, such as the main metal and woodworking shops, which do not require to be closed in, will be surrounded with a concrete wall 3 feet 6 inches high, above which there will be movable metal shutters or louvers as protection against wind and rain. Buildings such as the pattern shop and storehouse will have a second floor consisting of a reenforced concrete slab resting on steel beams and girders encased in concrete. For such buildings as the lumber shed, steel storage shed, etc., the first floor will be surfaced with cinders, sand, or gravel. For the main shops the floor will consist of a concrete base covered with 3½-inch creosoted wooden blocks. To permit convenient access at all times, and to prevent cutting into the floors of the buildings and the pavements outside, an underground tunnel, with main truck having a clear height of 6 feet and width of 4 feet 6 inches, and with branches of same height and a width of 3 feet 6 inches, is being constructed of reenforced concrete to connect with the principal buildings and the substation and air-compressor plant. This tunnel will contain all power, light, telephone, fire-alarm, etc., cables, and water, steam, fuel-oil, and compressed air mains, and the main sewer. Rain water will be carried

off the area occupied by the shop buildings by means of surface gutters and drains.

*Interior arrangements, power, and light.*—The selection and location of equipment in the different shops has been practically completed during the year. Electric power at 44,000 volts is to be delivered by the trans-Isthmian transmission line to a substation adjacent to the pump well of Dry Dock No. 1, where the voltage will be reduced to 2,200 volts for distribution. The shops have been arranged in four groups as regards electric distribution, and each group provided with transformers and switchboards for reducing the voltage from 2,200 to 230 for power and from 2,200 to 230–115 single-phase, three-wire, for lighting. All power used in the plant will be three-phase, 25-cycle, 220-volt, except 220-volt direct current in the machine shop for variable-speed tools. Duplicate motor-generator sets will be installed in the machine shop for generating the direct-current power required.

The following table shows the rated horsepower of all motors in each group and building for driving cranes, individual machines, and groups of machines:

Circuit No.	Build- ing.	Alternating current.					Direct current (individual).		Total alter- nating current horse- power.
		Cranes. Horse- power.	Groups.		Individual.		Num- ber.	Total horse- power.	
			Num- ber.	Total horse- power.	Num- ber.	Total horse- power.			
1.....	1	336	20	225	17	157	37	527	748
2.....	2	92½	2	40	6	60			
	3	57			4	30			
	4	199	2	22½	20	205			
	16				1	7½			
		348½	4	62½	31	312½			723½
3.....	8		5	70	28	627½			
	5				4	60			
			5	70	32	687½			757½
	12	168	2	15	12	181			
	10				3	120			
	7				1	20			
		168	2	15	16	321			504
Extension of No. 4.....	15				2	85			
	9	25½			3	60			
		25½			5	145			170½
Air compressors.....					3	1,832			1,832
Total.....							527		4,735½

The designs for the individual motorizing of 45 machines were completed during the year.

One air compressor having a capacity of 5,000 and two having a capacity of 2,400 cubic feet of free air per minute, each driven by synchronous motors, will be installed, to improve the power factor.

The greater number of the machines and tools for the permanent shops will be taken from the present shops. While many of those machines have seen hard service and are less efficient than those of

recent design, it is considered economical to install and use them until the character and quantity of work to be performed by the new plant becomes known with sufficient definiteness to enable the types and sizes of machines best adapted to the work to be selected. Among the machines to be purchased are one open-side, extension planer, 96 by 132 inches by 24 feet, one double-head lathe with a swing of ways of about 75 inches and between centers of 65 feet, and one 500-ton forging press.

A general illumination system, supplemented with additional local lights where necessary, has been adopted and the details for the lighting of the planing mill and foundry were completed. Tungsten lamps will be used.

#### CONTRACTS.

Contracts for the following material and equipment for the new shops were made during the year:

*Material.*—Seventy thousand feet single-duct vitrified tile to American Sewer Pipe Co., for \$5,950.

Channels, I beams, and angles for stringers to Belmont Iron Works, for \$5,250.

Composition roofing to Barrett Manufacturing Co., for \$3,709.94.

Trilby rail for building No. 1 to United States Steel Products Co., for \$441.58.

Steel for 4-foot diameter cylinders to J. B. Kendall Co., at \$10,343.14.

Steel for 3-foot diameter cylinders, girders, etc., for engine pits and transfer table to J. B. Kendall Co., at \$11,696.98.

Seventy-pound and 90-pound rails for crane runways to United States Steel Products Co., at \$2,471.92.

Twenty cloth pinions to General Electric Co., at \$227.

Hollow tile to National Fireproof Roofing Co., at \$7,632.80.

Trolley wire to United States Steel Products Co., at \$569.25.

Strain insulators to General Electric Co., at \$22.68.

Insulating spools to Globe Porcelain Co., at \$220.

Channels, angles, etc., for footwalks in trusses to R. C. Hoffman & Co., at \$2,008.87.

Creosoted wood blocks sufficient for paving 14,600 square yards of floor space to Republic Creosoting Co., at \$28,470.

*Equipment.*—Three 60-ton overhead electric cranes to Niles-Bement-Pond Co., for \$36,015, delivery before December 22, 1913.

Two 25-ton overhead electric cranes, and two 20-ton electric cranes, to Cleveland Crane & Engineering Co., for \$25,700, delivery before November 25, 1913.

Fifty-six induction motors, squirrel-cage type, including control apparatus, at \$21,737.52; 43 autostarters, at \$3,064.98; and three oil switches, at \$100, to General Electric Co., delivery before October 27, 1913.

Five reversing planer motor equipments to General Electric Co., at \$5,620, delivery September 27, 1913.

Twenty-six slip-ring, polar-wound rotor motors and 23 direct-current motors to General Electric Co., at \$40,040.60, delivery to begin October 9, 1913, and to be completed January 2, 1914.

Five 2-horsepower motors to Westinghouse Electric & Manufacturing Co., for \$973, delivery December 6, 1913.

One annealing furnace, one mold oven, and four core ovens, to Tate-Jones Co. (Inc.), for \$13,740.

Sand-blast plant equipment to Thomas W. Pangborn Co., for \$6,754.90, delivery September 19, 1913.

*Dry docks, coaling plants, and floating cranes.*—Designing work in connection with the dry docks, coaling plants, and floating cranes has been under the immediate charge of Civil Engineer F. H. Cooke, United States Navy, with a force of engineers, draftsmen, and assistants that numbered 12 at the end of the fiscal year. The services of the first division have been used in the design and preparation of contract plans and specifications of the miter gates for Dry Dock No. 1 and accessories, and of the floating caisson for Dry Dock No. 2, in connection with similar work of the first division, on which Mr. Henry Goldmark, designing engineer, has been in immediate charge; and in the design of the wagon-body valves for the dry docks, by Assistant Engineer T. E. L. Lipsey.

*General description of dry docks.*—The general design of dry docks at Balboa has been worked out during the year so that the preparation of the detail drawings may proceed.

*Dry Dock No. 1, principal dimensions.*

	Feet.
Length over all.....	1,110.0
Maximum length of ship dockable.....	1,000.0
Width of entrance, clear.....	110.0
Width of body of dock at coping.....	140.0
Width of body of dock at floor.....	117.0
Depth, coping to floor.....	56.0
Height of keel blocks.....	4.5
Depth of water over top of blocks:	
Mean sea level.....	35.0
Mean high water.....	41.5
Mean low water.....	29.3

This dock will rest on rock, and for a considerable portion of its depth will be in solid rock. It will be constructed practically wholly of concrete, the only cut-stone work being the caisson seat and the miter sill and quoins. Normally the closure will be a pair of mitering gate leaves, very similar to those for the canal locks, and operated by machines practically identical to those operating lock gates. Beyond the gate proper there will be provided a seat for the floating caisson that will be constructed for general canal use, at a sufficient distance from the gate to enable it to be painted and repaired in the dry when the caisson is in place.

The dock will be flooded by means of longitudinal duets formed in the concrete side walls, communicating with the dock body through grated openings in the dock floor along the bottom of the side walls. The flow of water will be controlled by four metal wagon-body valves operated by suitable machinery. The flooding intakes will be protected by metal screens, and chases for emergency valves will be provided whereby the wagon-body valves may be inspected, painted, and repaired, either in place or by being wholly withdrawn. The time required for flooding at extreme high water should not exceed about 25 minutes with all valves open.

The pumping plant for emptying the dock will consist of four vertical shaft centrifugal pumps, driven by electric motors. The diameter

of the discharge of these pumps will be approximately 54 inches. There will further be provided two drainage pumps of approximately 20-inch discharge diameter, and one small bilge pump for dealing with seepage into the pump well itself. All these pumps will be located in a suitable well, the motors and other electrical parts being protected by a house provided with the necessary cranes, etc. The discharge from the pumps will be carried through a concrete duct entirely separate from the flooding ducts, and all necessary screens, nonreturn valves, etc., will be provided. The time required for pumping out should not exceed 2 hours and 10 minutes at mean high water, under which circumstances approximately 5,900,000 cubic feet of water must be removed from the dock against an average head of approximately 22.5 feet.

Suitable tracks for a 50-ton locomotive jib crane, as well as tracks of the standard gauge of the Panama Railroad, will be provided entirely around the dock. All necessary capstans and bollards are to be installed and a pipe tunnel with suitable outlets to body of dock will be constructed around the dock. There will be stairways leading to the floor of the dock on each side at the entrance, on each side at the head, and at two points along the length of each side wall, at which latter points material slides will also be provided.

The docking keel blocks will be adjustable to fit the ship to be docked, and this adjustability will be attained by means of noncorrosive metal sockets located at proper intervals in the dock floor.

*Miter gates and gate-moving machinery.*—Contract dated October 22, 1912, was entered into with the McClintic-Marshall Construction Co. of Pittsburgh, Pa., for one pair of steel miter-gate leaves and fixed irons, to be fabricated and delivered on the Isthmus within 425 days of date of contract. The McClintic-Marshall Construction Co. was the only bidder under Circular No. 725, which was issued for the purchase of these leaves and under which proposals were opened September 26, 1912. The bidder made an "original" item with four alternates thereto, the latter dealing with reduced time of delivery at increased cost and reduced price on account of omitting the erection of one leaf at the shops prior to shipment. As erection on the Isthmus was not required, it was considered advisable to retain the provision for erecting one leaf in the shop to insure accurate and speedy erection later on, and the contract was accordingly awarded on the "original" item at an approximate price of \$105,000, the exact price being determined by applying the contract unit prices to the actual scale weights of the finished parts.

This gate closes an opening 110 feet wide, of a height of 56 feet from sill to coping. There are approximately 1,900,000 pounds of metal in the two leaves, and 115,000 pounds of metal in the fixed parts forming the anchorage.

The gate for Dry Dock No. 1 differs from those for the canal locks in that the miter and quoin ends are to be fitted with green-heart bearing pieces, rather than with the metal bearing pieces provided for the canal gates. This change was adopted in the interest of watertightness, as the dock will stand dry for the greater portion of the time, and to reduce the amount of metal exposed to the action of sea water. The timber quoin posts will bear against granite hollow quoins and the "clapping sill" at the bottom of the gate will bear against a granite miter sill. These changes necessitated certain structural

changes in the ends of the metal gate structure, but aside from this the gates are practically identical with those for the locks, except that the footwalk on the top is the full width of the gate, and no miter forcing machine will be provided, as such seems unnecessary for dry dock use.

The mill and shop inspection of the gate leaves is being made by the same force as for the lock gates; and at the close of the fiscal year 50 per cent of the structural steelwork had been completed, 90 per cent of the castings had been cast, and 15 per cent of the latter had been machined and completed.

The gate-moving machines are being purchased under the increase clause of contracts for similar material for the locks. There have thus been purchased the following:

Two crank gear recess cover seats, ordered July 24, 1912, from the Standard Foundry Co., of Buffalo, N. Y., at \$330.67 each.....	\$661. 34
Two miter gate moving machines, one right hand, one left hand, ordered on Dec. 13, 1912, from the Wheeling Mold & Foundry Co., of Wheeling, W. Va., W. O. 27467-C.....	13, 752. 66
Two 35 h. p. motors, ordered from the General Electric Co., Schenectady, N. Y., Dec. 10, 1912, W. O. 27762-C.....	956. 08
Starting panels, switches, controls, etc., for the above, ordered from the General Electric Co., Dec. 10, 1912, W. O. 32230-C.....	872. 64
	<hr/> 16, 242. 72

The foregoing material after receipt on the Isthmus will be stored and protected until needed.

*Dry Dock No. 2, principal dimensions.*

	Ft.	in.
Length over all.....	376	0
Maximum length of ship dockable.....	350	0
Width of entrance, clear.....	71	0
Width of body of dock at coping.....	92	0
Width of body of dock at floor.....	80	0
Depth, coping to floor.....	37	4
Height of keel blocks.....	4	0
Depth of water over top of blocks:		
Mean sea level.....	16	10
Mean high water.....	23	4
Mean low water.....	11	2

This dry dock is in lieu of the two marine railways originally contemplated, the Navy Department having expressed a preference for such a dock and the local conditions having rendered its construction more advisable. This dry dock will also be founded on rock, but the greater part of its walls will be of gravity section. The dock will be closed by a floating steel caisson bearing against granite sills when in place. The dock will be flooded normally by means of concrete ducts and floor gratings similar to those for Dock No. 1, but of reduced dimensions. The flow of water will be controlled by one metal wagon-body valve similar to those for Dry Dock No. 1. An auxiliary means of flooding will be provided by pipes and valves in the caisson. The dock will be emptied by means of the pumping plant of Dry Dock No. 1, the necessary valves and gratings being provided. Access to the floor of the dock will be by means of four stairways, two at the entrance and two at the head, and alongside each of the latter two a material slide will be constructed. This dock will be served by the locomotive jib crane mentioned under Dry Dock No. 1, and will, in general, be provided with the same accessories as Dry Dock No. 1.

The caisson for closing the entrance has presented an unusual problem, for in order to take advantage of the dock at low stages of tide, at which time there will still be sufficient depth over the blocks to accommodate shallow draft canal craft such as barges, dredges, etc., the floating caisson must be capable of operation with a proper margin of stability at such low stages of tide.

The dimensions of this structure will be approximately as follows:

	Ft.	in.
Length molded.....	74	6
Height molded.....	40	0
Beam, maximum.....	25	0

Approximate weight (including permanent ballast), 638 tons.

For pumping out the caisson there will be provided two 15-inch electrically driven centrifugal pumps. The top deck of the caisson will form a roadway of sufficient width to accommodate vehicles.

*Floating cranes.*—In anticipation of requirements that will develop after the completion of the canal, investigation has been made by representatives of the Isthmian Canal Commission, reports submitted and inspection made, during the past two years, of the principal floating cranes in use in the United States and Canada, as well as abroad, and the experience and facilities of different manufacturers have been ascertained, with a view to determining the type of crane that will best meet canal requirements. The conclusion was early reached that two floating cranes of the largest size would be necessary to meet conditions that might arise in handling lock and dock gate leaves. These cranes will also have to meet the requirements, as regards reach and lifting capacity, of the Navy Department; they must be able to handle the heaviest guns and armament in connection with canal fortifications, and they must be capable of performing suitable lifting operations in connection with commercial freight and repairs to commercial vessels, as well as the performance of wrecking service both from a military and commercial standpoint. To meet these conditions Circular 743 was issued October 30, 1912, calling for the construction and delivery of two floating cranes, of the revolving type, having a maximum lifting capacity of 250 gross tons.

The following proposals were opened under this circular on January 13, 1913:

1. Neumeyer & Dimond, as agents for the Deutsche Maschinen Fabrik, A. G., of Duisburg, Germany:  
Two cranes, \$820,350; time 580 days.  
One crane, \$420,175; time 550 days.
2. Werf Gusto, Schiedam, near Rotterdam, Holland:  
Two cranes, \$920,000; no time.  
One crane, \$460,000; no time.
3. Cowans, Sheldon Co. (Ltd.), Carlisle, England:  
Two cranes, £230,000; time 548 days.  
One crane, £115,250; time 548 days.
4. Wellman-Seaver-Morgan Co., Cleveland, Ohio:  
Two cranes, \$1,450,000; time 690 days.  
One crane, \$745,000; time 690 days.

Award was made April 17, 1913, to the lowest bidder, the Deutsche Maschinen Fabrik, A. G., in the approximate amount of \$827,550, based on delivery of two similar cranes in 580 days. The difference between the above approximate amount and the bid price of \$820,350



is due to certain alternate items and to modifications in some minor details, all such modifications having been definitely agreed upon prior to formal contract. These cranes are now under construction. Mr. Henry Schoellhorn, formerly mechanical engineer of the mechanical division, was sent to Duisburg as the local inspector under the Washington office of the commission.

The manufacture of large floating cranes is a specialty in which very few firms have had experience. It will be noted that of the four bidders one was from the United States, one from England, one from Holland, and one from Germany, and these four firms manufacture the best types of large cranes that are in existence. The only American bidder was about 77 per cent higher in cost than the low bidder. This difference in price, however, is largely accounted for by the increased weight of material offered by the American bidder. Award was made to the foreign bidder under authority of act of June 25, 1906, providing "that purchase of material and equipment for use in the construction of the Panama Canal shall be restricted to articles of domestic production and manufacture, from the lowest responsible bidder, unless the President shall, in any case, deem the bids or tenders therefor to be extortionate or unreasonable."

Under date of March 2, 1909, this joint resolution was interpreted by the President, so far as it refers to bids on foreign material, as follows:

The following Executive instructions in furtherance of joint resolution No. 35 of June 25, 1906 (34 Stat. L., 835), will hereafter control in comparing bids for materials to be used in connection with the construction of the Panama Canal and in determining awards thereon:

When bids submitted on material of foreign production are lower than on material of domestic production and manufacture preference will be given to the article of domestic production and manufacture, unless the bid for the latter exceeds the former by an amount equal to the duty of the imported article. Where an article of domestic manufacture is made up, in part, of imported ingredients or components the presence of such components will be ignored, if duty has been paid. If, however, the article is manufactured in bond, or if the bid is based on a drawback being paid or allowed, the amount of such duty or drawback should be similarly considered in making the award.

*General description.*—Each crane consists essentially of a steel pontoon 150 feet long, 88 feet wide, and 16 feet 3 inches average depth, containing a power-generating plant, and supporting the fixed and revolving superstructure. The power is "steam-electric," steam being supplied by a Scotch marine boiler, coal fired. Electric energy is generated at 220 volts direct current by steam generators. All motions of the hooks are controlled by one operator. The pontoon is not self-propelling, but is fitted with a powerful steam capstan at each of the four corners for warping the crane into any desired position, and is further fitted with suitable towing bits, cleats, etc., and with two 3,000-pound anchors handled by team.

The fixed and revolving superstructure is centered at a point 39 feet distant from one end of the pontoon and midway of its width. The fixed superstructure consists of a truncated steel framed pyramid supporting at its top the revolving superstructure. This latter consists of two parts, the "bell" which surrounds the pyramid, and which supports the jib, machinery room, and operator's cab, and the jib which is hinged to the bell at its top and carries the main and auxiliary hoist. Rotation about the vertical axis is had by power applied

between the bell and pyramid near the foot of the latter. Movement of the jib in a vertical plane is had by means of two links attached to the jib and to carriages driven by vertical screw spindles, these latter being at the rear of the bell and vertically over the machinery house.

This design of superstructure eliminates virtually all uncertainty as to how the loads are carried. All vertical loads, dead and live, of the revolving superstructure are concentrated at the top of the pyramid. The overturning moment of the live, dead, and wind loads of the revolving superstructure is resisted by horizontal forces applied at the top and bottom of the pyramid. The clearances are such that no part of the revolving superstructure, except the jib, overhangs the pontoon in any position, and the heights of superstructure are such that unencumbered passage around it is provided in all positions. An area 20 feet by 60 feet on the deck of the pontoon is made especially strong, being capable of carrying a superimposed load of 2,000 pounds per square foot, this area being intended for the reception of loads up to a total of 300 gross tons. The cranes can, therefore, carry very heavy and bulky loads on their decks when it is necessary to transport them anywhere on the canal, thus rendering unnecessary the use of barges, etc., for this purpose.

The jib is provided with two hoists designated the "main hoist" and "auxiliary hoist," respectively. The main hoist is fixed at the point of the jib and will consist of two equal blocks, each of a rated capacity of 125 gross tons. These two blocks can be linked together by means of an "equalizer bar," whereby they may be made to form substantially one hoist of 250 tons capacity. Each block of the main hoist will be suspended in 10 parts of 2-inch wire rope.

The auxiliary hoist will have a rated capacity of 15 gross tons and will consist of a two-part block swung from a traveling trolley running on a runway secured to the lower side of the jib in such manner that the auxiliary hoist can be operated at any point of this runway in any position of the jib. The main hoist can handle its rated loads at any point in a full circumference of 360°. It can revolve completely under maximum loads and can in addition be luffed in or out by means of the above-mentioned links and screw spindles. The main hoist will have the following capacities at the reaches stated for each. By "reach" is meant the horizontal distance from face of pontoon fender to center of block.

	100 tons.	150 tons.	250 tons.
	<i>Feet.</i>	<i>Feet.</i>	<i>Feet.</i>
Loaded reach over end.....	80.1	59.0	21.0
Loaded reach over side.....	81.6	62.4	22.3

From any of these reaches the main load can be luffed in sufficiently far to enable the crane to deposit such load on its own deck.

The time of hoisting main loads is as follows:

<i>Tons per minute.</i>	<i>Ft. in.</i>
250.....	3 6
125.....	7 0
62.5.....	14 0

The unloaded blocks are raised or lowered at not less than 20 feet per minute. The crane can make one complete revolution in from 5 to 8 minutes, depending on the load and the wind, the lower figure being the most favorable condition without wind. The jib loaded with 100 tons can be luffed in from its maximum to minimum reach in not more than 17 minutes and luffed out in not more than 13 minutes. Without load the jib can be fully luffed in from maximum to minimum reach in not more than 10 minutes and luffed out in not more than 8 minutes. The speed of hoisting the fully loaded auxiliary block will be not less than 40 feet per minute, and the unloaded auxiliary block can be raised or lowered at not less than 80 feet per minute. The speed of trolleying the auxiliary hoist along the runway will be from 40 to 80 feet per minute, depending upon the degree of inclination of the jib.

Each crane will be safely stable in a wind exerting a pressure of 40 pounds per square foot, even with full 300-ton deck load on the pontoon. Of course the operation of the cranes would not be attempted in a gale. The pontoon will have a freeboard of not less than  $3\frac{1}{2}$  feet when handling maximum capacity loads in any position without deck load; if the deck load be present this freeboard will be reduced to not less than 2 feet. The maximum longitudinal inclination of the pontoon will not exceed  $2\frac{1}{2}^{\circ}$  and the maximum transverse inclination will not be greater than  $5^{\circ}$ . Each crane will be provided with ladders, stairs, gangways, etc., for convenient communication, inspection, and repair; will be equipped with all necessary signals and means of communication; and will be electric lighted throughout.

*Other floating equipment.*—In order that the canal may be equipped with harbor tugs of suitable design and sufficient power so that not more than two of them will be required to handle the largest vessels using the canal for docking and undocking, as well as towing through any portion of the canal, investigation and inspection of the most modern and largest harbor tugs in use along the Atlantic coast of the United States and in the leading ports of England has been made by representatives of the Isthmian Canal Commission during the past two years and reports have been submitted with full data in regard to the present practice, and recommendations have been made concerning the characteristics of the proposed tugs. An estimate for the purchase of four of these tugs was included in the estimates for the fiscal year 1913-14, and at the close of the fiscal year 1913 it was expected to proceed at once with the preparation of plans and specifications for these tugs, to be known as "Type A" tugs, in order that they can be ready for use by January 1, 1915. These tugs will be supplemented by a number of commission tugs as soon as they are needed and can be spared from the construction work on which they are now engaged.

No steps were taken during the year toward fitting up any of the commission sand and rock barges for use after completion of the canal as coal barges. This work will be taken in hand when the barges can be spared from construction use and before any coal barges are required for the new coaling plants.

*Coaling plants.*—Work has proceeded during the year on plans and specifications for the main coaling plant at the Atlantic terminus and for the subsidiary coaling plant at the Pacific terminus, along the lines described in the annual report for 1912. The procedure adopted has

been to invite proposals on the coal handling machinery, as described in general specifications, the substructure and all other work in connection with the plants to be performed by the commission with its own forces, and the latter to be designed to fit the machinery for which contracts are to be made.

In general, the Pacific plant will be half the size, as regards storage and handling capacity, of the Atlantic plant. The storage capacities of the plants will be sufficient to meet the military needs as recommended by the Navy Department. The specified rates of unloading coal from vessels into the storage piles have been fixed by the capacity of standard unloading machines, and the desire to be able to unload two vessels at one time at the Atlantic plant, with two unloading machines to each vessel, and one vessel at the Pacific plant with two machines. The reloading capacity of the Atlantic plant, that is, transferring coal from storage into collier or barge, has been fixed after consideration of the reloading capacity of modern commercial plants in the United States. The capacity of each reloading machine and the desire to equip the Atlantic plant so that two vessels can be loaded at one time with two machines serving each vessel, and the Pacific plant so that one vessel can be loaded with two machines, has determined the capacity specified for each plant and the number of machines to be furnished.

During the year the policy has been adopted of providing storage in connection with both plants for coal piles of individuals and companies who desire to participate in the business of supplying vessels that use the canal with coal; and the plants have been so designed that these private coal piles can be served conveniently with the same machinery that handles the Government coal. It is desired to encourage individuals and companies in the business of furnishing fuel to vessels that use the canal. Until legislation is secured permitting it, the Isthmian Canal Commission has no authority to lease any land, or land under water, in the Canal Zone, except in accordance with act of February 27, 1909, which permits the leasing of land for agricultural purposes. Until contractual relations with individuals and companies are therefore authorized there will not be sufficient inducement offered to make the investment of capital in coaling wharves, piers, dredging, etc., attractive, as leases may be granted at present only under a revocable license, terminable at the pleasure of the Government, without liability for reimbursement on account of any improvements made.

The amount of rental of the areas for the storage of coal under revocable license has not yet been fixed. In addition to rent there will be, in the case of improvements made on the area in question by the licensee, a real-estate tax of 1 per cent per annum of the value of the improvements and a merchandise tax of 5 cents for each 2,000 pounds of coal sold. The handling charges for putting coal into storage and taking it out, charges for the use of coal barges, and other labor in connection with this service will be reasonable, and it is expected that coal belonging to individuals and companies will be subject to practically the same charges as the Government coal.

Circular 763 was issued February 13, 1913, inviting proposals on coal-handling machinery and accessories for the Atlantic and Pacific plants. The Atlantic plant will lie on the north end of Mindi Island,

between the French and American Canals, opposite Dock 11, Cristobal. Railroad connection to this plant will be secured by a spur from the Panama Railroad main line crossing the French Canal opposite Mount Hope, which work was well under way at the end of the fiscal year. The Pacific plant has been located at the outer end of the approach wall, southeast of the dry-dock entrance. Circular 763 was accompanied by general plans showing the general location and character of each plant.

*General description.*—The Atlantic plant was specified to consist of not less than 1,000 linear feet of unloading wharf, not less than 1,000 linear feet of reloading wharf, and a coal pile 1,000 feet long by 250 feet wide, the coal being stored to a maximum depth of 50 feet, of which the bottom 20 feet will be permanently under salt water. Coal is to be taken from water carrier into storage by means of four unloading towers having a combined normal capacity of 1,000 tons per hour. It is to be reclaimed from storage and reloaded to colliers or barges by means of two reclaiming bridges and four movable reloaders, these units having a combined normal capacity of 2,000 tons per hour. A conveying system will transport the coal between the various operating units in use. The storage capacity of the original pile, 1,000 by 250 feet, was as follows:

	Tons.
Wet.....	125, 000
Normal dry.....	121, 000
Emergency dry.....	52, 800
Total.....	298, 800

The location adopted permits the extension of this pile in length of about 700 feet.

The terms "wet," "normal dry," and "emergency dry," are applied to the lowest 20 feet (in salt water), the next 20 feet, and the top 10 feet, respectively. Tons are short tons of 2,000 pounds each, 40 cubic feet of coal being considered equivalent to 1 ton.

For the Pacific plant the circular specified two alternate plans, designated as "N" and "O," respectively. In plan "N" the length of unloading and reloading wharf, length of coal pile, and number of operating units were specified as half that for the Atlantic plant in each case, thus the normal unloading capacity was 500 tons per hour and the normal reclaiming and reloading capacity was 1,000 tons per hour. Although the width of coal pile was specified to be the same as that at the Atlantic plant, i. e., 250 feet, the storage capacity will be somewhat greater than one-half that for the Atlantic plant, as the "wet" storage is 24 feet deep at Balboa, making the total 54 feet deep instead of 50 feet. The increased depth of "wet" storage results from the elevation at which rock is found on the site, together with the greater tidal oscillation. Under plan "O" Balboa, it is contemplated to utilize the four berm cranes which were used in the Pacific division for handling concrete at Pedro Miguel and Miraflores Locks, these cranes making it unnecessary to purchase new stocking and reclaiming bridges to span the coal pile. At the same time a somewhat greater storage capacity is obtained with the greater reach of these berm cranes. The number of unloaders and reloaders and the handling capacity are the same as for plan "N" Balboa, the necessary changes being made in the conveying system to serve the berm cranes. The

relative storage capacities for the two designs at Balboa are shown in the following table:

	Plan "O."	Plan "N."
	<i>Tons.</i>	<i>Tons.</i>
Wet.....	100,000	75,000
Normal dry.....	80,000	60,000
Emergency dry.....	30,000	25,000
Total.....	210,000	160,000

Proposals under Circular 763 were opened in the Washington office June 14, 1913, and were received on the Isthmus for canvass just prior to the close of the fiscal year. These proposals were accompanied by plans, specifications, information, and other data. Five proposals were received, each of which is listed below:

Bidder.	Cristobal only.	Balboa only, plan "N."	Both complete.	Time of delivery.
				<i>Months.</i>
David Duncan, 17 Battery Place, New York City.....	\$2,121,660	\$1,140,830	\$3,262,490	18
Hunt Construction Co., 45 Broadway, New York.....	2,111,813	1,361,285	3,350,497	18
Augustus Smith, Bayonne, N. J.....	1,413,689	901,373	2,300,000	36
W. L. Bull, jr., Inc., 135 Front St., N. Y.....	2,313,750	1,581,000	3,894,750	22
Wellman-Seaver-Morgan Co., Cleveland, Ohio.....	960,260	631,130	1,573,390	18

There were 19 items listed in the circular whereby the work might be subdivided if advantageous, but for convenience as a general indication of the price received, the bids for Cristobal only, for Balboa plan "N" only, and for both complete, are shown. But one bidder, Augustus Smith, submitted a proposal under plan "O," his bid being \$570,000 for this design, time of completion both plants, with plan "O" Balboa, 34 months. The proposal of the Wellman-Seaver-Morgan Co. is based on a completely alternate design from that described in the specifications accompanying Circular 763. These proposals were being canvassed at the close of the fiscal year.

*Fuel-oil plants.*—Work has proceeded during the year on the fuel-oil plants as described in the annual report for 1912. October 1, 1912, contract was made with the Petroleum Iron Works Co., of Sharon, Pa., for four storage tanks 93 feet in diameter by 35 feet high, capacity 40,000 barrels, erected complete, at a total cost of \$62,800. At the end of the year these tanks had been practically completed, two at Mount Hope and two on Balboa dump southeast of Sosa Hill, and plans were under way to connect them up with the water front.

During the year the policy has been adopted for the Government to retain complete control of the terminals, water frontage, and transportation across the Isthmus by land and water. This would include all pipe lines across the Isthmus. It is proposed to equip the wharf in the vicinity of the coaling station at the Pacific terminals, and Docks 13 and 14 at Mount Hope on the Atlantic side, with fuel-oil supply and delivery mains, in duplicate, together with the necessary pumps so that the Government will be able to satisfactorily handle all fuel oil, including fuel oil of individuals and companies who may wish to participate in the fuel-oil business on the Isthmus.

The general terms will be the same as those applying to the coaling business. At the close of the year sites for the fuel-oil tanks at each terminus, of individuals and companies, were under consideration. It seems that the most available and desirable area on the Atlantic side lies east and south of Mount Hope Cemetery, between the Mount Hope Road and the east diversion canal. On the Pacific side the most suitable area is on Balboa dump southeast of Sosa Hill.

In addition to the rental charge for the land to be occupied by oil tanks, individuals and companies will be subject to a tax of 1 per cent of the value of improvements made by them and to a merchandise tax of  $1\frac{1}{4}$  cents per barrel on all sales of fuel oil. The rates to be charged individuals and companies for piping oil will be practically the same rates that will be charged against oil owned by the Government. On March 31, 1913, the contract with the Union Oil Co., for fuel oil used by the commission, expired, and this contract was renewed for a period of 15 months. The price of oil is \$1.10 per barrel of 42 gallons, pumped into commission tanks. The construction of an oil pipe line across the Isthmus had not been authorized up to the end of the fiscal year.

*Quay walls and Pier No. 1.*—The design and the preparation of working drawings for the quay walls adjacent to the Panama Railroad new concrete dock at Balboa, for Pier No. 1, including the pier shed, and for quay wall construction and the landings for small boats at the head of the slips on each side of Pier No. 1 have been under the immediate direction of Mr. W. Rowland, junior engineer. The general plan of the section of the quay wall northeast of the Panama Railroad new concrete dock (known as section "g-h-i") and of Pier No. 1 had been prepared and approved by Division Engineer S. B. Williamson prior to his resignation on December 12, 1912. Since that time the detail drawings of this work have been completed, and work has started on quay wall section "e-f," southwest of Panama Railroad new concrete dock, and on the quay walls at the head of Slip No. 1 and Slip No. 2.

*General description, quay wall section "g-h-i."*—This section extends between the northeast end of the Panama Railroad new concrete dock and the head of Slip No. 1, a distance of about 1,238 feet. The substructure consists of rows of reenforced concrete cylinders 7 feet 6 inches in diameter sunk to rock, three cylinders to a row, with rows spaced about 35 feet apart. The superstructure consists of a  $7\frac{1}{2}$ -inch floor slab of reenforced concrete supported by reenforced concrete longitudinal stringers framed between reenforced concrete cross girders. The wearing surface will be vitrified brick, laid on edge, with a  $\frac{3}{4}$ -inch sand cushion between the brick and floor slab. The floor is 60 feet wide, with one railroad track along the water front. This wharf has a live load capacity of 680 pounds per square foot.

*Pier No. 1.*—The substructure consists of the same type of concrete cylinders as used on quay wall section "g-h-i." The pier will be 201 feet wide by 1,000 feet long, will have one railroad track along each side, and two depressed railroad tracks through the center. The pier consists of two concrete wharves, each supported on rows of cylinders, three cylinders to a row, with rows spaced 29 feet 6 inches apart. For a width of 50 feet in the center the floor will be supported on a rock fill. Comparative estimates on reenforced con-

crete and steel incased in concrete led to the adoption of reenforced concrete for the floor girders and stringers as being more economical.

The pier will be paved with vitrified brick, laid on edge, and it will have a live-load capacity of 750 pounds per square foot. The pier will be covered with a steel frame shed 160 feet wide and 1,000 feet long.

*Small boat landings.*—At the head of Slip No. 1 and Slip No. 2, on each side of Pier No. 1, there will be a landing for small boats, consisting of about 303 feet of quay wall. In each slip there will be a floating landing about 242 feet long, composed of two reenforced concrete pontoons each about 121 feet by 27 feet, with two inclined bridges 90 feet long and 5 feet wide in the clear.

*Quay wall, section "e-f."*—This section of quay wall lies immediately southwest of the Panama Railroad new concrete dock, and will be about 775 feet in length and 60 feet in width. This quay wall will be built in water. The substructure will consist of 6-foot reenforced concrete cylinders, three in a row, with rows about 21 feet center to center. In order to make the excavation and to place concrete in the dry, steel forms will be used. Above mud line it is proposed to use special bolted-up forms that can be removed by a diver. This wharf will be subjected to unusually heavy loads, as it will form the main repair wharf, and, in addition, a portion of the wharf will be fitted up with two of the sand cranes now in use at Balboa, and sand will be regularly transferred from barges to cars on it as long as it is necessary to maintain the sand service of the sixth division. A portion of the wharf can be used for the temporary storage of sand in bins if desired.

As this wharf will be built over the water, the longitudinal and transverse girders will be of steel encased in concrete. The reenforced concrete floor slab will have a thickness of 7 inches, on which will be laid vitrified paving brick. The live load which the wharf will be capable of carrying will be 1,000 pounds per square foot.

### PERMANENT SETTLEMENTS.

During the latter part of the year an area along the edge of Balboa dump, south of Sosa Hill, was set aside for a permanent settlement for silver employees at the Pacific terminus; aside from this, there has been no change in the permanent settlements described in the annual report for 1912, which include Cristobal at the Atlantic terminus, Gatun and Pedro Miguel at the Atlantic and Pacific locks, respectively, and Balboa and Ancon at the Pacific terminus.

### METEOROLOGICAL AND HYDROGRAPHIC SECTION.

The work of this section during the fiscal year has been under the immediate charge of Supervisor F. D. Willson, with Mr. H. G. Cornthwaite, principal meteorologist, and Mr. H. T. Critchlow, principal hydrographer.

*General.*—The three first-class meteorological stations—Ancon, Culebra, and Colon—were continued in operation throughout the year, each with full complement of instruments, and in charge of a skilled observer. Wind records were continued at Gatun, Pedro Miguel, Sosa, and Miraflores. The records at the latter station were obtained



for use by the department of sanitation in the study of mosquito flight.

Twenty-six rainfall stations are maintained, 15 equipped with standard and 11 with automatic rain gauges.

Evaporation records are obtained from the following stations: Ancon, Rio Grande Reservoir, Gatun Lake, Brazos Brook reservoir, and Colon.

Duplicate tide registers are in operation at Colon and Balboa, where automatic records of the sea temperature are also obtained.

Seismograph stations are maintained at Ancon and Gatun.

Maximum and minimum temperatures, from instruments exposed to the direct rays of the sun, were obtained at Miraflores dumps for the use of the Fortification Board. Hydrographic stations were continued at Vigia, Alhajuela, Gamboa, Gatun, and Trinidad. Regular field work has been carried on by the hydrographers at different stations.

All current meters used on discharge measurement work were calibrated at the Gamboa rating station. Twenty-three ratings were made during the fiscal year.

Regular gauging work was discontinued on the smaller streams at the end of the year 1912, the work being interfered with by backwater from the lake.

Special hydrographic survey was made of the lower end of the Gatun spillway channel from the lower end of the concrete channel to a point 50 feet below the present cable station. A contour map was plotted from the data obtained.

The gauge rods in Gatun Lake were checked from precise level bench marks in the vicinity of each station, and small adjustments, found necessary from continuous water-level observations obtained during the dry season of 1912, were made.

*Office work.*—Daily meteorological and hydrographic reports have been received from the various stations and published for the information of the various divisions. All observations and gaugings have been computed, checked, tabulated, and filed. Monthly discharge curves have been constructed, and discharge tables made. Data from current meter ratings have been calculated, checked, and rating tables compiled. Monthly reports of meteorological and hydrographic conditions have been submitted. The work of flood predictions and warnings was handled in the central office.

#### METEOROLOGY.

*Weather.*—The weather experienced on the Isthmus during the calendar year 1912 was in many respects similar to that which prevailed during the preceding year. The rainfall, relative humidity, and atmospheric pressure were generally deficient, while the air temperature and wind movement were above normal.

*Precipitation.*—The rainfall on the Isthmus during the calendar year 1912 was everywhere below normal except along the immediate Pacific coast, but it was generally heavier than the annual rainfall in 1911. The 1912 precipitation exceeded the values for the previous year at all stations except Rio Grande, Camacho, Alhajuela, Monte Lirio, and Porto Bello. The annual totals ranged from 71.78 inches at Ancon to 147.61 inches at Porto Bello. Balboa reported the least

number of rainy days, 148, and Brazos Brook the greatest number, 282. The monthly rainfall records for 1912, 1913, and the station averages are shown in Table No. 1.

The maximum 24-hour precipitation recorded during the year 1912 was 7.23 inches at Ancon on May 12-13. Daily quantities in excess of 4 inches were recorded as follows:

Stations.	Date.	Amount.	Stations.	Date.	Amount.
		<i>Inches.</i>			<i>Inches.</i>
Ancon.....	May 12	7.06	Porto Bello.....	Sept. 14	4.02
Balboa.....	do ...	7.00	Camacho.....	Sept. 22	4.17
Porto Bello.....	May 21	6.41	Miraflores.....	Nov. 11	4.70
Brazos Brook.....	July 17	6.15	Do .....	Dec. 30	4.04
Gorgona.....	Aug. 19	4.10			

A large part of the 1912 deficiency in rainfall occurred during the dry-season months—January to April, inclusive. The dry-season rainfall amounted to but 5 per cent of the annual total in the Pacific section and 4 per cent in the Central and Atlantic sections. The following table presents the average section rainfall and the total number of rainy days for the year 1912:

Section.	Average rainfall, year 1912.	Rainy days.
	<i>Inches.</i>	
Pacific.....	76.59	161
Central.....	89.68	203
Atlantic.....	125.36	251

Table No. 2 presents the monthly rainfall records by sections for the year 1912, while the maximum rainfall of record for periods of 5 minutes, 1 hour, and 24 hours at the stations equipped with automatic registers is shown in Table No. 3. Table No. 4 gives the hourly distribution of rainfall at selected stations during the year 1912. From this table it may be seen that the heaviest rains usually occur between the hours of 2 and 3 p. m., and that the percentage of rainfall during working hours is much higher in the Pacific section than in the Atlantic section, where a relatively large percentage of the annual rainfall occurs during the night.

During the first six months of 1913 the rainfall has continued generally below normal, although the deficiencies as a rule have been small.

#### TEMPERATURE.

The average air temperatures for the year 1912 were well above normal, especially during the dry season months. The maximum temperatures recorded at Ancon and Culebra in April, 1912, established new high temperature records for these stations. March was the warmest month at Ancon, and April at Culebra and Colon, while November was the coolest month at all stations.

The means and extremes in temperature for the year 1912 are presented in the following table:

Station.	Maximum.		Minimum.		Annual mean.
	°F.	Date.	°F.	Date.	
Ancon.....	97	Apr. 7	66	Feb. 1	80.7
Culebra.....	96	Apr. 17 <sup>1</sup>	65	Feb. 2	79.6
Colon.....	91	May 5	71	Feb. 10	80.7

<sup>1</sup> Same temperature recorded on May 5.

The absolute maximum and minimum temperature of record at the three first-class meteorological stations are shown below:

*Absolute temperatures of record.*

[Revised to June 30, 1913.]

Station.	Maximum.		Minimum.	
	°F.	Date.	°F.	Date.
Ancon.....	97	Apr. 7, 1912	63	Jan. 27, 1910
Culebra.....	96	Apr. 17, 1912 <sup>1</sup>	61	Mar. 21, 1910
Colon.....	92	June 3, 1909	66	Dec. 3, 1909

<sup>1</sup> Same temperature recorded on May 5, 1912.

NOTES.—The lowest temperature of record on the Isthmus is 59° F. observed at Bas Obispo on Feb. 9, 1907. The maximum temperature record at Ancon—97° F.—was equaled at the Naos Island station on Feb. 13, 1906.

Practically normal conditions of air temperature prevailed during the first six months of 1913.

Monthly temperature records and other weather data for the year 1912 at the principal stations are presented in Tables Nos. 5, 6, and 7.

WINDS.

There was a notable excess in wind movement during the year 1912. The average velocities were abnormally high during the dry season months. The prevailing direction was from the northwest at Ancon and Culebra, and from the north at Colon. March was the windiest month at all stations, and June the month of least wind movement. No unusually high velocities were recorded at any of the first-class stations, although a maximum velocity of 49 miles an hour from the east was recorded at the Gatun station on August 7, 1912, during a local rain squall.

Wind records on Sosa Hill were continued throughout the year for comparison with the Ancon records. The average wind movement for the fiscal year 1912-13 was 43 per cent greater at Sosa than at Ancon, due to the higher elevation and better exposure of the Sosa instruments. The prevailing direction was from the northwest at each station. Northwest wind prevailed 80 per cent of the time at Sosa and 58 per cent of the time at Ancon. The maximum velocities recorded during the fiscal year were 48 miles an hour from the south on June 11 at Sosa and 32 miles from the south on the same date at Ancon. Comparative monthly wind records for these stations are presented in Table No. 8.

The following table, revised to June 30, 1913, shows the maximum wind velocities of record at the first-class stations:

*Maximum velocity.*

Station.	Miles per hour.	Direction.	Date.
Ancon.....	59	S.....	July 10, 1909
Culebra.....	39	N.....	July 20, 1910
Colon.....	40	S.....	July 16, 1908

ATMOSPHERIC PRESSURE.

The annual mean atmospheric pressure for 1912 was slightly below normal. April was the month of highest mean pressure, and December the month of lowest pressure at all stations except Colon, where the lowest pressure occurred in September.

RELATIVE HUMIDITY.

The relative humidity was also below normal during the year 1912. The lowest average humidity occurred in March and the highest in October and November. The annual means for 1912 (from bi-hourly readings) were 81 per cent at Ancon, 82 per cent at Culebra, and 83 per cent at Colon.

CLOUDINESS.

Approximately normal conditions of cloudiness prevailed during the year 1912. The daytime cloudiness was somewhat heavier along the Pacific coast than over the central and Atlantic sections. The average cloudiness for the first six months of 1913 was generally deficient except during the month of May.

EVAPORATION.

Weather conditions during 1912 favored a high rate of evaporation and the annual totals were the highest of record at all stations. Evaporations during the first half of 1913 continued abnormally heavy. The monthly records are shown in Table No. 9. The following table gives the 1912 and average annual evaporation at the various stations:

*Annual evaporation.*

Station.	1912	Average.
	<i>Inches.</i>	<i>Inches.</i>
Ancon.....	57.428	46.877
Rio Grande.....	58.501	53.137
Gatun.....	61.184	61.032
Brazos Brook.....	60.929	54.547

FOGS.

Night fogs were of frequent occurrence at the interior stations in the Canal Zone during the rainy season, 1912, but less frequent during the dry-season months. Few fogs were observed at either coast station. Practically all fogs lifted or were dissipated by 8.30 a. m.

## SEA TEMPERATURE.

The average surface temperature of the sea water for the year 1912 was normal at Colon, but 2° F. below normal at Balboa. The maximum sea temperature recorded during the year at Balboa was 86° F. in June and the minimum 67° F. in February and March. The maximum at Colon was 87° F. in May and June and the minimum 78° in March. The monthly means and extremes at each station are shown in Table No. 10.

## TIDAL CONDITIONS.

Tide registers were continued in operation at Balboa and Colon. The tide extremes of record at these stations are given below (length of record, six years), table revised to June 30, 1913.

Station.	Maximum high water.		Extreme low water.		Maximum daily range. <sup>1</sup>		Minimum daily range. <sup>1</sup>	
	Elevation.	Date.	Elevation.	Date.	Feet.	Date.	Feet.	Date.
Balboa.....	+ 11.2	Oct. 2, 1909	-10.6	Apr. 11, 1910	20.8	Apr. 11, 1910	5.1	Mar. 24, 1911
Colon.....	+ 1.65	Nov. 27, 1909	- 1.01	June 9, 1910	2.17	June 28, 1911	( <sup>2</sup> )	

<sup>1</sup> For consecutive tides.

<sup>2</sup> One tidal fluctuation often entirely absent at Colon.

NOTE.—Elevations in feet referred to mean sea level.

Tide conditions on the Atlantic and Pacific coasts for the year 1912 are shown in Table No. 11.

## SEISMOLOGY.

A number of seismic disturbances were registered at Ancon and Gatun during the fiscal year 1912-13. Most of these disturbances were slight tremors due to quakes of distant origin. All were shocks of insufficient intensity to be sensibly felt in the Canal Zone, and no damage resulted from them. A complete list of the seismic disturbances recorded at Ancon during the year is presented in Table No. 12. The records at Gatun agree in most respects with the Ancon records.

The following plates and tables accompany the report of the meteorological section:

Plates:

No. 108. Annual rainfall along canal location.

No. 109. Wind roses, year 1912, dry and rainy seasons.

Tables:

1. Monthly rainfall on the Isthmus of Panama.
2. Monthly rainfall by sections, year 1912, and averages.
3. Maximum rainfall in Canal Zone.
4. Hourly distribution of rainfall in Canal Zone.
5. Monthly meteorological data—Ancon, year 1912.
6. Monthly meteorological data—Culebra, year 1912.
7. Monthly meteorological data—Colon, year 1912.
8. Comparative Ancon and Sosa wind records.
9. Monthly evaporation—Canal Zone, 1912, 1913, and averages.
10. Sea temperatures—year 1912.
11. Tidal conditions—year 1912.
12. Seismograph records, Ancon, year ended June 30, 1913.

TABLE No. 1.—*Monthly rainfall on the Isthmus of Panama, 1912-13, and station averages.*

[Values in inches.]

Station.	July.	August.	Septem-ber.	October.	Novem-ber.	Decem-ber.	January.	February.	March.	April.	May.	June.	Annual.
Ancon:													
1912 for 15 years.....	10.25	6.33	8.38	17.89	6.38	3.27	T.	0.08	0.01	2.68	10.71	5.80	71.78
1913 for 15 years.....	8.16	7.53	7.46	10.92	10.45	4.18	0.63	.22	.43	2.03	8.27	8.15	71.25
Average for 15 years.....							1.02	.86	.78	2.76	8.98	8.15	
Balboa:													
1912 for 14 years.....	9.76	6.79	10.01	15.75	6.14	4.94	.00	.18	.00	2.88	9.56	5.88	71.89
1913 for 14 years.....	9.88	7.55	6.79	9.55	9.09	5.98	.78	.19	.00	.06	8.04	7.15	
Average for 14 years.....							1.11	.57	.84	4.09	7.22	7.95	70.62
Miraflores:													
1912 for 4 years.....	8.37	11.35	14.45	15.44	11.89	6.75	.00	.34	.00	4.79	7.60	7.51	88.49
1913 for 4 years.....	9.20	9.21	11.04	12.99	12.23	8.16	2.65	2.49	.00	3.78	12.33	9.49	
Average for 4 years.....							2.01	1.65	.90	3.78	9.22	10.83	91.22
Pedro Miguel:													
1912 for 5 years.....	11.54	9.51	10.76	10.48	8.43	3.91	.00	.22	.02	4.23	6.92	9.09	75.71
1913 for 5 years.....	9.11	8.88	8.91	12.54	10.99	7.38	1.10	.07	.00	1.04	13.48	9.00	
Average for 5 years.....							.99	1.08	.44	3.62	10.59	10.31	84.84
Rio Grande:													
1912 for 8 years.....	9.11	13.19	15.10	9.46	7.01	4.04	.03	.33	.03	3.03	7.18	6.63	75.14
1913 for 8 years.....	11.04	10.34	11.18	13.10	11.12	5.93	2.09	.48	.30	1.12	12.33	8.05	
Average for 8 years.....							1.35	.68	.33	3.52	10.91	9.34	88.84
Culebra:													
1912 for 22 years.....	10.12	12.88	14.12	10.15	7.59	4.87	.05	.33	.02	3.14	8.15	7.57	78.99
1913 for 22 years.....	9.52	10.58	11.23	11.54	12.30	7.68	1.57	.78	.57	3.80	11.74	9.10	
Average for 22 years.....							1.75	.56	.68	3.90	11.16	8.86	89.66
Camacho:													
1912 for 6 years.....	10.87	13.77	14.14	11.57	7.06	3.46	.04	.65	.06	2.44	6.15	7.77	77.98
1913 for 6 years.....	10.87	10.43	11.11	14.14	13.29	6.64	1.60	.44	.00	2.52	16.03	9.65	
Average for 6 years.....							1.20	.82	.58	3.32	11.38	10.11	94.09
Empire:													
1912 for 8 years.....	9.15	10.53	13.78	12.44	7.24	3.71	.01	.34	.01	2.64	6.21	8.50	74.56
1913 for 8 years.....	9.32	9.72	8.31	14.05	10.99	5.57	1.67	.79	.22	.90	11.74	11.48	
Average for 8 years.....							.73	.55	.43	3.56	9.64	8.27	81.14
Gamboa:													
1912 for 30 years.....	14.27	16.64	12.75	13.60	6.56	3.63	.06	1.11	.10	.77	7.94	11.64	89.07
1913 for 30 years.....	10.44	12.20	10.50	12.80	12.26	6.97	2.65	.68	.08	1.07	15.13	8.02	
Average for 30 years.....							1.84	.85	.84	3.54	10.91	9.70	92.85
Juan Mina:													
1912 for 2 years.....	9.96	11.04	14.27	12.71	12.75	2.02	.15	.90	.07	.86	10.86	12.65	88.24
1913 for 2 years.....	9.22	11.96	11.42	12.42	12.53	6.42	1.01	.94	.36	.54	13.20	9.97	
Average for 2 years.....							.10	1.14	.14	1.70	13.38	10.88	91.31

Alhajuela:	10.17	12.87	9.12	13.52	9.62	2.20	.08	.33	.02	.20	13.43	12.17	83.73
1912 for 13 years.	13.23	13.08	11.60	13.52	14.24	7.08	.96	.22	.08	.72	12.63	11.51	104.26
Average for 13 years.							1.23	.79	.66	3.22	12.75	12.86	
El Viga:													
1912 for 4 years.	13.95	14.96	10.10	14.85	10.79	1.53	.08	.62	.08	.37	12.81	14.51	94.65
1913 for 4 years.	12.99	13.44	12.78	16.12	16.45	6.52	.78	2.78	.85	.98	13.35	13.89	111.50
Average for 4 years.							1.22	.78	.85	2.10	12.36	13.89	
Gorgona:													
1912 for 8 years.	10.46	14.82	12.80	16.89	7.15	4.80	.20	.35	.02	.71	8.03	14.82	91.05
1913 for 8 years.	11.21	12.21	12.46	13.53	13.11	7.03	3.17	.30	.03	3.48	13.82	9.48	97.98
Average for 8 years.							1.85	.86	.98	2.87	12.35	9.52	
Frijoles:													
1912.	9.87	13.63	11.93	19.20	15.88	5.65	.67	3.01	.10	1.19	10.28	13.25	104.66
1913.							3.85	3.03	.29	2.44	21.07	8.72	
Trinidad:													
1912 for 5 years.	11.80	7.68	11.36	16.80	20.36	5.61	1.38	1.15	.28	3.03	11.79	11.80	103.04
1913 for 5 years.	9.52	11.28	12.20	15.17	21.91	11.21	3.45	1.80	1.11	2.52	17.73	11.20	
Average for 5 years.							3.32	2.85	3.17	5.20	14.08	11.08	120.99
Monte Lirio:													
1912 for 5 years.	11.60	8.15	9.39	21.17	16.35	5.24	2.14	3.32	.24	1.29	8.34	13.51	100.74
1913 for 5 years.	14.13	11.14	12.11	16.60	24.46	11.09	3.57	2.52	.60	3.54	16.29	10.71	
Average for 5 years.							3.61	4.35	3.76	4.88	14.34	13.62	134.09
Gatun:													
1912 for 6 years.	11.84	11.98	7.84	14.52	19.18	9.82	.91	2.38	.55	4.18	13.83	14.80	111.83
1913 for 6 years.	12.41	14.34	9.70	16.62	22.40	13.38	4.63	2.92	1.01	5.38	17.06	10.70	
Average for 6 years.							3.83	2.40	2.91	4.05	15.66	13.78	131.48
Brazos Brook:													
1912 for 6 years.	16.85	14.42	9.11	17.97	21.86	9.63	.61	2.26	.53	.85	11.45	19.12	124.66
1913 for 6 years.	16.88	14.68	11.57	15.19	24.69	14.19	5.72	4.20	.71	5.23	18.77	12.17	
Average for 6 years.							3.52	2.30	3.24	3.16	13.18	15.39	138.49
Colon:													
1912 for 42 years.	13.13	9.87	12.23	17.65	21.81	11.47	.28	1.81	.66	.75	12.03	15.90	117.59
1913 for 42 years.	16.38	15.01	12.53	14.29	21.86	12.31	6.71	1.75	.79	2.69	22.60	11.81	
Average for 42 years.							3.96	1.47	1.67	4.08	12.41	13.35	120.32
Porto Bello:													
1912 for 5 years.	24.21	14.15	15.03	17.01	25.82	11.52	.67	1.64	.60	.54	16.65	19.77	147.61
1913 for 5 years.	19.56	17.65	13.66	11.26	29.60	22.33	5.84	2.03	1.17	2.34	30.51	9.00	
Average for 5 years.							7.84	4.55	2.76	6.56	15.18	17.55	168.50

One year only.

NOTE.—Station averages do not include records for the year 1913.

TABLE NO. 2.—*Monthly rainfall by sections, Canal Zone—Year 1912 and averages.*

[Values in inches.]

Month.	Pacific section.		Central section.		Atlantic section.	
	1912	Average.	1912	Average.	1912	Average.
January.....	0.01	1.30	0.44	1.62	0.62	4.79
February.....	.23	.97	1.10	1.69	2.02	2.68
March.....	.01	.66	.09	1.21	.58	2.64
April.....	3.52	3.55	1.51	3.65	1.58	4.46
May.....	8.39	9.37	9.45	12.29	13.49	14.11
June.....	7.10	9.32	11.65	10.99	17.34	15.14
July.....	9.81	9.48	11.11	11.22	16.51	16.31
August.....	9.43	8.70	12.45	11.89	12.60	15.42
September.....	11.74	9.08	12.16	11.37	11.05	11.86
October.....	13.80	11.82	14.81	13.99	16.79	14.34
November.....	7.97	10.78	11.03	15.54	22.17	24.64
December.....	4.58	6.33	3.88	7.90	10.61	15.55
Year.....	76.58	81.36	89.68	103.36	125.36	141.94

NOTE.—Means are based on the records from 5 stations in the Pacific section, 11 in the Central section, and 4 in the Atlantic section. All available records are used in computing averages.

TABLE NO. 3.—*Maximum rainfall in Canal Zone Oct. 1, 1905, to June 30, 1913.*

Stations.	Maximum rainfall.					
	5 minutes.		1 hour.		24 hours. <sup>1</sup>	
	Inches.	Date.	Inches.	Date.	Inches.	Date.
Ancon (Oct. 1, 1905).....	0.64	Aug. 7, 1908	3.98	Oct. 9, 1911	7.23	May 12-13, 1912.
Balboa (June 10, 1906).....	.90	May 12, 1912	5.86	June 2, 1906	7.57	Nov. 16-17, 1906.
Pedro Miguel (Jan. 1, 1908).....	.60	Nov. 11, 1908	3.30	Aug. 27, 1908	4.56	Sept. 30-Oct. 1, 1909.
Rio Grande (Dec. 29, 1905).....	.75	July 24, 1908	3.10	Sept. 21, 1912	6.00	Dec. 2-3, 1906.
Culebra (July 1, 1906).....	.64	May 2, 1908	3.69	Oct. 16, 1907	5.55	Dec. 3, 1906. <sup>2</sup>
Empire (July 18, 1906).....	.60	July 25, 1906	3.63	Oct. 1, 1909	6.15	Do.
Gamboa (Nov. 18, 1905).....	.59	July 27, 1908	3.32	May 11, 1911	6.56	Dec. 2-3, 1906.
Alhajuela (Mar. 31, 1907).....	.60	July 20, 1909	3.40	Dec. 28, 1909	8.19	Dec. 3, 1906. <sup>2</sup>
Gatun (Aug. 24, 1907).....	.62	Aug. 3, 1912	3.82	May 26, 1910	10.48	Do.
Colon (Oct. 1, 1905).....	.64	Aug. 25, 1909	4.90	Oct. 8, 1909	8.53	Dec. 2-3, 1906.
Porto Bello (May 1, 1908).....	<sup>3</sup> 2.48	Nov. 29, 1911	4.53	Nov. 29, 1911	10.86	Dec. 28-29, 1909.

<sup>1</sup> Maximum fall in any 24 consecutive hours.

<sup>2</sup> No automatic record on this date; total for 24 hours ending at noon.

<sup>3</sup> Approximate; automatic record indistinct, due to unusually excessive rate of fall.

NOTE.—Dates in parentheses opposite station names refer to installation of automatic rainfall registers.

TABLE NO. 4.—*Hourly distribution of rainfall in Canal Zone, year 1912.*

[Values in inches.]

Station.	Total annual rainfall.	Hourly rainfall.					
		Rainfall during working hours, 7 a. m. to 5 p. m.		Maximum.		Minimum.	
		Amount.	Per cent of total.	Hour of maximum.	Accumulated amount.	Hour of minimum.	Accumulated amount.
Ancon.....	71.78	45.37	63	2-3 p. m. . .	10.27	1-2 a. m. . .	0.32
Balboa.....	71.89	44.34	62	2-3 p. m. . .	10.69	1-2 a. m. . .	.29
Pedro Miguel.....	75.71	57.95	77	2-3 p. m. . .	14.88	2-3 a. m. . .	.16
Rio Grande.....	75.14	53.13	71	2-3 p. m. . .	15.15	4-5 a. m., and 11 p. m.	.28
Culebra.....	78.99	43.45	55	2-3 p. m. . .	14.51	11 p. m. . .	.27
Gamboa.....	89.07	68.14	77	3-4 p. m. . .	16.20	10-11 p. m.	.27
Alhajuela.....	83.73	65.70	78	2-3 p. m. . .	15.44	1-2 a. m. . .	.34
Gatun.....	111.83	48.28	43	3-4 p. m. . .	8.50	9-10 a. m. . .	2.56
Colon.....	117.59	44.26	38	5-6 a. m. . .	8.25	8-9 p. m. . .	1.91
Porto Bello.....	147.61	72.58	49	2-3 p. m. . .	12.51	6-7 p. m. . .	2.65



TABLE NO. 5.—*Monthly meteorological data—Ancon, Canal Zone, year 1912.*

Month.	Atmospheric pressure (inches).		Air temperature (degrees Fahrenheit).								Mean wet thermometer.	Mean temperature, dew point.	Mean relative humidity (per cent).
	Station. <sup>1</sup>	Sea level.	Monthly mean.	Maximum.	Day.	Mean maximum.	Minimum.	Day.	Mean minimum.	Maximum daily range.			
January.....	29.742	29.838	80.6	93	22	91	68	26	71	23	72	70	82
February.....	29.762	29.858	81.3	94	19	91	66	1	71	26	72	70	82
March.....	29.749	29.844	83.0	96	7	94	69	12	72	24	73	71	77
April.....	29.770	29.865	82.1	97	7	92	69	2	72	26	74	72	78
May.....	29.732	29.828	82.0	96	7	90	71	20	74	21	76	75	87
June.....	29.742	29.837	80.8	94	21	89	70	16	73	23	76	75	90
July.....	29.728	29.833	80.6	94	27	88	70	14	73	19	75	74	91
August.....	29.728	29.824	80.2	94	31	88	69	7	72	21	75	75	90
September.....	29.726	29.822	79.4	92	9	87	68	24	72	20	75	74	91
October.....	29.735	29.830	79.0	92	5	86	69	29	72	19	75	74	93
November.....	29.736	29.831	79.0	91	26	86	69	17	74	21	74	74	92
December.....	29.722	29.818	80.8	93	5	90	69	18	72	21	74	73	89
Year.....	29.739	29.835	80.7	97	47	89.3	66	51	72.3	26	74.2	73.1	86.8

Month.	Precipitation (inches).			Wind.					Number of days.				Average cloudiness. <sup>a</sup>
	Monthly total.	Normal. <sup>2</sup>	Rainy days.	Total movement (miles).	Prevailing direction.	Maximum velocity.			Clear.	Part cloudy.	Cloudy.	Thunderstorms.	
						Miles per hour.	Direction.	Day.					
January.....	T.	1.02	0	8,564	NW.	24	NW.	3	17	14	0	1	3.8
February.....	0.08	.86	2	7,705	NW.	29	NW.	23	3	17	9	0	6.1
March.....	.01	.78	1	8,965	NW.	30	NW.	1	3	26	2	0	5.6
April.....	2.68	2.76	5	6,390	NW.	25	N.	5	8	16	6	6	5.1
May.....	10.71	8.98	14	4,999	NW.	23	NW.	3	0	15	16	14	7.7
June.....	5.80	8.15	13	4,118	NW.	34	S.	15	0	18	12	20	7.4
July.....	10.25	8.16	20	5,176	NW.	24	SE.	14	1	10	20	18	7.8
August.....	6.33	7.53	20	5,024	NW.	24	N.	18	1	14	16	18	7.3
September.....	8.38	7.46	20	4,451	NW.	31	NE.	23	0	14	16	20	7.6
October.....	17.89	10.92	23	4,538	NW.	23	S.	28	1	11	19	14	7.5
November.....	6.38	10.45	22	5,105	NW.	25	NW.	17	2	13	15	5	6.9
December.....	3.27	4.18	13	5,007	NW.	20	NW.	16	6	16	9	9	5.8
Year.....	71.78	71.25	153	70,042	NW.	34	S.	615	42	184	140	125	6.6

<sup>1</sup> Elevation of barometer 92 feet above sea level.<sup>2</sup> Average for 14 years' record.<sup>3</sup> Tenths of sky.<sup>4</sup> April.<sup>5</sup> February.<sup>6</sup> June.

TABLE NO. 6.—*Monthly meteorological data—Culebra, Canal Zone, year 1912.*

Month.	Atmospheric pressure (inches).		Air temperature (degrees Fahrenheit).								Mean wet thermometer.	Mean temperature dew point.	Mean relative humidity (per cent).
	Station. <sup>1</sup>	Sea level.	Monthly mean.	Maximum.	Day.	Mean maximum.	Minimum.	Day.	Mean minimum.	Maximum daily range.			
January.....	29.438	29.851	79.0	90	8	87	68	27	70	21	71	70	85
February.....	29.460	29.874	79.2	91	10	88	65	2	71	24	72	70	84
March.....	29.442	29.854	80.4	92	7	89	68	12	72	23	72	70	79
April.....	29.464	29.874	81.4	96	17	91	67	2	72	27	73	70	79
May.....	29.430	29.840	81.2	96	5	89	70	20	74	22	75	74	87
June.....	29.436	29.848	80.2	91	21	88	70	16	73	20	75	74	92
July.....	29.420	29.832	79.8	91	12	86	70	17	73	18	74	74	92
August.....	29.423	29.836	79.5	92	8	87	69	12	72	19	74	73	92
September.....	29.422	29.834	78.7	90	1	86	67	24	72	21	74	73	93
October.....	29.430	29.844	78.6	90	5	86	68	29	72	17	73	73	93
November.....	29.428	29.842	78.0	88	22	84	69	17	72	17	73	72	93
December.....	29.414	29.828	78.8	88	1	86	67	18	72	19	73	72	91
Year.....	29.434	29.846	79.6	96	45	87.2	65	62	72.1	27	73.2	72.1	88.3

Month.	Precipitation (inches).			Wind.					Number of days.				Average cloudiness. <sup>3</sup>
	Monthly total.	Normal. <sup>2</sup>	Rainy days.	Total movement (miles).	Prevailing direction.	Maximum velocity.			Clear.	Part cloudy.	Cloudy.	Thunderstorms.	
						Miles per hour.	Direction.	Day.					
January.....	0.05	1.75	2	7,697	NW.	28	NW.	31	17	14	0	0	3.5
February.....	.33	.56	4	7,864	NW.	30	NW.	24	9	20	0	0	4.3
March.....	.02	.68	1	8,893	NW.	35	N.	4	9	22	0	0	4.1
April.....	3.14	3.80	4	7,059	NW.	30	N.	25	6	21	3	2	4.9
May.....	8.15	11.16	15	5,538	NW.	27	SW.	8	0	11	20	15	7.4
June.....	7.57	8.86	21	3,715	NW.	25	SE.	15	0	9	21	21	7.8
July.....	10.12	9.52	22	4,962	NW.	36	NE.	30	0	13	18	14	7.7
August.....	12.88	10.58	19	4,592	NW.	33	NE.	12	2	12	17	23	7.3
September.....	14.12	11.23	20	3,975	NW.	32	NE.	23	1	10	19	22	7.5
October.....	10.15	11.54	25	3,505	NW.	21	N.	7	0	9	22	22	7.6
November.....	7.59	12.30	24	5,039	NW.	27	NW.	17	0	15	15	11	7.4
December.....	4.87	7.68	15	5,567	NW.	24	N.	9	6	20	5	7	5.2
Year.....	78.99	89.66	172	68,406	NW.	36	NE.	630	50	176	140	137	6.2

<sup>1</sup> Elevation of barometer 404 feet above sea level.<sup>2</sup> Average for 22 years' record.<sup>3</sup> Tenths of sky.<sup>4</sup> May.<sup>5</sup> February.<sup>6</sup> July.

TABLE NO. 7.—Monthly meteorological data—Colon, Republic of Panama, year 1912.

Month.	Atmospheric pressure (inches).		Air temperature (degrees Fahrenheit).								Mean wet thermometer.	Mean temperature dew point.	Mean relative humidity (per cent).
	Station. <sup>1</sup>	Sea level.	Monthly mean.	Maximum.	Day.	Mean maximum.	Minimum.	Day.	Mean minimum.	Maximum daily range.			
January.....	29.862	29.872	82.2	88	23	86	76	8	78	11	74	72	77
February.....	29.880	29.892	80.8	88	27	85	71	10	77	15	75	73	72
March.....	29.870	29.882	82.4	88	29	87	76	11	78	11	75	73	79
April.....	29.886	29.897	82.8	90	20	88	74	18	78	15	75	73	78
May.....	29.844	29.854	82.0	91	5	87	73	21	77	14	77	76	85
June.....	29.849	29.860	80.2	89	9	84	73	16	76	15	77	76	88
July.....	29.841	29.852	80.6	89	27	84	71	1	77	14	77	76	88
August.....	29.836	29.846	80.2	89	9	84	72	7	76	14	76	75	87
September.....	29.829	29.840	79.4	89	17	84	71	25	75	15	76	75	87
October.....	29.834	29.846	79.0	88	12	84	72	29	75	14	75	74	88
November.....	29.840	29.850	78.6	88	5	82	73	14	75	14	76	74	89
December.....	29.834	29.845	80.4	87	26	84	73	17	76	12	76	74	84
Year.....	29.850	29.861	80.7	91	45	84.9	71	5 10	76.5	15	75.8	74.2	84.3

Month.	Precipitation (inches).			Wind.				Number of days.				Average cloudiness. <sup>3</sup>	
	Monthly total.	Normal. <sup>2</sup>	Rainy days.	Total movement (miles).	Prevailing direction.	Maximum velocity.			Clear.	Part cloudy.	Cloudy.		Thunderstorms.
						Miles per hour.	Direction.	Day.					
January.....	0.28	3.96	9	10,772	N.	32	NE.	5	7	23	1	0	4.9
February.....	1.81	1.47	15	10,066	N.	32	N.	8	5	21	3	0	5.5
March.....	0.66	1.67	11	12,550	N.	33	NE.	5	13	16	2	0	4.4
April.....	0.75	4.08	6	10,620	N.	33	NE.	24	16	12	2	0	3.7
May.....	12.03	12.41	17	7,614	N.	26	NE.	18	2	17	12	12	6.6
June.....	15.90	13.35	24	5,165	W.	26	NE.	17	1	15	14	19	7.3
July.....	13.13	16.38	26	7,574	N.	25	NE.	28	3	12	16	8	7.1
August.....	9.87	15.01	20	6,892	N.	29	W.	19	1	18	12	21	6.8
September.....	12.23	12.53	22	5,473	SE.	37	W.	2	3	10	17	16	7.0
October.....	17.65	14.29	26	5,490	SE.	38	SW.	23	1	12	18	14	7.5
November.....	21.81	21.86	27	7,519	W.	34	NW.	17	0	10	20	10	8.4
December.....	11.47	12.31	21	8,992	NE.	29	NE.	13	9	17	5	1	5.3
Year.....	117.59	129.32	224	98,727	N.	38	SW.	6 23	61	183	122	101	6.2

<sup>1</sup> Elevation of barometer 10 feet above sea level.<sup>2</sup> Average for 42 years' record.<sup>3</sup> Tenths of sky.<sup>4</sup> May.<sup>5</sup> February.<sup>6</sup> October.

TABLE NO. 8.—*Comparative wind records—Ancon and Sosa, fiscal year 1912–13.*

Month.	Ancon.					Sosa.					Excess wind movement (per cent). <sup>1</sup>
	Average hourly wind movement.	Per cent NW. wind.	Maximum velocity.			Average hourly wind movement.	Per cent NW. wind.	Maximum velocity.			
			Miles per hour.	Direction.	Day.			Miles per hour.	Direction.	Day.	
1912.											
July.....	7.0	70	24	SE.	14	10.5	90	44	SE.	14	50
August.....	6.8	55	24	N.	18	9.9	76	40	NE.	23	46
September.....	6.2	48	31	NE.	23	8.9	71	39	SE.	14	44
October.....	6.1	37	23	S.	28	7.6	59	28	NW.	22	25
November.....	7.1	47	25	NW.	17	9.7	66	36	NW.	17	37
December.....	6.7	58	20	NW.	16	9.8	88	27	NW.	16	46
1913.											
January.....	7.3	64	21	N.	29	10.7	89	30	NW.	7	45
February.....	9.3	68	26	N.	10	13.3	94	36	NW.	17	44
March.....	10.6	77	26	NW.	23	15.6	96	36	NW.	23	47
April.....	9.7	69	24	N.	2	13.5	88	36	NW.	5	40
May.....	6.7	63	20	N.	1	9.4	79	34	NW.	1	40
June.....	5.5	43	32	S.	11	8.0	61	48	S.	11	45
Year.....	7.4	58	32	S.	<sup>2</sup> 11	10.6	80	48	S.	<sup>2</sup> 11	43

<sup>1</sup> Sosa records compared with Ancon.<sup>2</sup> June.

NOTE.—Elevation of Ancon anemometer 69 feet above ground and approximately 160 feet above mean sea level. Sosa anemometer 25 feet above ground and approximately 220 feet above mean sea level.

TABLE NO. 9.—*Monthly evaporation—Canal Zone, years 1912, 1913, and averages.*

[Value in inches.]

Month.	Ancon.			Rio Grande.			Gatun.			Brazos Brook.		
	1912	1913	Average.	1912	1913	Average.	1912	1913	Average.	1912	1913	Average.
January....	7.370	5.935	4.889	6.363	5.392	5.577	7.208	5.435	6.322	6.066	6.387	5.842
February....	6.755	6.439	5.384	6.134	5.844	5.605	6.048	6.889	6.468	5.572	6.616	5.493
March.....	7.795	7.816	6.480	77.099	6.762	6.832	7.649	8.602	8.126	7.081	8.455	7.140
April.....	5.721	6.465	4.813	6.732	6.436	5.454	7.394	7.333	7.364	7.321	7.466	5.663
May.....	3.746	3.963	3.149	5.350	4.033	4.372	5.335	4.606	4.970	5.707	4.167	4.474
June.....	3.098	3.615	2.708	3.836	3.812	3.388	3.263	5.083	3.031	3.729	4.500	3.492
July.....	3.386	.....	3.018	3.908	.....	3.715	3.889	.....	4.224	4.425	.....	3.710
August.....	3.648	.....	3.021	3.983	.....	3.749	4.316	.....	4.362	4.611	.....	3.906
September..	3.395	.....	3.120	3.335	.....	3.719	3.799	.....	4.191	4.487	.....	4.140
October.....	3.458	.....	3.314	3.763	.....	3.590	4.123	.....	3.866	3.970	.....	4.063
November...	3.723	.....	2.956	3.275	.....	3.010	3.351	.....	3.016	3.100	.....	2.834
December..	5.333	.....	4.025	4.723	.....	4.126	4.809	.....	5.092	4.860	.....	3.790
Year.....	57.428	.....	46.877	58.501	.....	53.137	61.184	.....	61.032	60.929	.....	54.547
Daily mean	.157	.....	.128	.160	.....	.146	.167	.....	.167	.166	.....	.149

NOTE.—Averages at Rio Grande and Brazos Brook are based on four years' record; Ancon five years' record; and Gatun two years' record.

Evaporation measurements are from floating pans 4 feet in diameter and 10 inches deep at Rio Grande, Gatun and Brazos Brook, and insulated tank 10 inches in diameter at Ancon.

For monthly evaporation during past years, see previous annual reports.

TABLE No. 10.—*Sea temperatures, 1912.*

[Temperatures of water in degrees Fahrenheit.]

Month	Pacific Ocean (Balboa).					Atlantic Ocean (Colon).				
	Maxi- mum.	Date.	Mini- mum.	Date.	Month- ly mean.	Maxi- mum.	Date.	Mini- mum.	Date.	Month- ly mean.
January.....	82	1	72	14	75.5	84	26	79	16	80.9
February.....	76	16	67	26	71.2	83	11	80	12	80.7
March.....	74	12	67	11	70.6	84	11	78	15	81.1
April.....	82	22	68	11	74.4	86	18	80	16	82.8
May.....	85	12	73	11	80.4	87	9	80	22	83.4
June.....	86	19	81	11	83.3	87	7	80	30	83.7
July.....	84	15	80	15	82.0	86	11	80	17	82.7
August.....	84	14	81	11	82.1	86	18	80	13	82.6
September.....	83	11	80	27	81.9	85	11	80	18	82.0
October.....	83	15	80	27	81.8	85	11	80	12	82.2
November.....	82	12	79	18	80.6	84	11	79	28	81.3
December.....	83	20	79	1	81.6	84	14	79	16	81.5
The year.....	86	29	67	(3)	78.8	87	(4)	78	(5)	82.1

<sup>1</sup> Same temperature recorded on other dates also.<sup>2</sup> June.<sup>3</sup> Several dates.<sup>4</sup> May and June.<sup>5</sup> March.TABLE No. 11.—*Tidal conditions, year 1912.*

[Elevations in feet referred to mean sea level.]

## PACIFIC COAST (BALBOA).

Month.	Maximum high water.		Extreme low water.		Maximum daily range. <sup>1</sup>		Minimum daily range. <sup>1</sup>	
	Elevation.	Date.	Elevation.	Date.	Elevation.	Date.	Elevation.	Date. <sup>2</sup>
January.....	+ 9.6	7	-9.6	6	18.9	6-7	7.3	14
February.....	+ 9.7	5	-9.8	4	19.4	5	6.0	12
March.....	+ 9.4	5	-9.9	5	19.3	5	5.2	13
April.....	+ 8.7	2	-9.5	3	18.1	2	5.3	11
May.....	+ 8.9	19	-8.7	1	17.3	18	5.9	10
June.....	+ 9.0	17	-8.7	17	17.7	17	6.8	8
July.....	+ 9.5	17-18	-9.1	16	18.5	16	7.8	10, 24
August.....	+10.0	15	-9.4	14	19.4	15	6.4	23
September....	+10.2	13	-9.4	12	19.6	13	5.8	21
October.....	+10.2	12	-8.9	11	19.0	11	5.4	20
November....	+ 8.8	8-9	-8.4	9	17.2	9	5.6	18
December....	+ 9.2	28	-8.6	26	17.5	26	6.6	18
Year....	+10.2	(3)	-9.9	45	19.6	5 13	5.2	4 13

## ATLANTIC COAST (COLON).

Month.....	Elevation.	Date.	Elevation.	Date.	Elevation.	Date.	Elevation.	Date.
January.....	+1.34	3	-0.82	5	1.99	6	0.23	30
February.....	+1.26	27	-.73	1	1.71	1	.21	23
March.....	+1.10	1	-.72	26	1.59	25	.21	6 2
April.....	+ .87	21	-.89	23	1.66	21	.21	23
May.....	+1.22	28	-.82	7	1.77	20	.24	13
June.....	+1.27	17	-.63	16	1.90	17	.22	7
July.....	+1.30	12	-.60	14	1.82	13	.24	6 17
August.....	+1.48	11	-.37	21	1.65	9	.20	31
September....	+1.37	6	-.44	16	1.59	7	.20	6 2
October.....	+1.31	4	-.51	30	1.55	4	.20	14
November....	+1.34	11	-.67	17	1.67	27	.23	20
December....	+1.42	26	-.56	7	1.67	26	.24	1
Year....	+1.48	7 11	-.89	23	1.99	9 6	.20	(10)

<sup>1</sup> For consecutive tides.<sup>2</sup> One tidal fluctuation is often entirely absent at Colon.<sup>3</sup> Sept. 13 and October 12.<sup>4</sup> March.<sup>5</sup> September.<sup>6</sup> Other dates also.<sup>7</sup> August.<sup>8</sup> April.<sup>9</sup> January.<sup>10</sup> Several dates

TABLE NO. 12.—*Seismograph records, Ancon, Canal Zone (latitude, 8° 57' north; longitude, 79° 32' west), year ended June 30, 1913.*

[100-K. Bosh-Omori seismographs. Greenwich mean time, midnight to midnight.]

Date.	Component.	Time of beginning.		Long waves.	Time of—		Maximum amplitude.	Approximate distance of epicenter.
		Preliminary tremors.	Second preliminary tremors.		Maximum.	End.		
1912.								
July 7.....	N-S.	8.09	Absent.	8.32	8.44	9.17	<i>Mm.</i> 1.5	<i>Miles.</i> 4,700
	E-W.	8.11	Absent.	8.32	8.43	9.09	1.0	.....
July 7.....	N-S.	22.52	Absent.	22.53	22.53	23.07	.6	(?)
	E-W.	Absent.	Absent.	(?)	22.43	(?)	.2	.....
July 18.....	N-S.	21.30	Absent.	21.39	21.42	22.00	1.0	2,000
	E-W.	(?)	Absent.	21.39	21.41	21.55	.3	.....
July 24.....	N-S.	12.03	Absent.	12.08	12.06	12.40	11.0	800
	E-W.	12.03	Absent.	12.08	12.04	12.38	3.0	.....
July 27.....	N-S.	(?)	Absent.	11.58	11.58	12.00	.2	(?)
	E-W.	(?)	Absent.	11.58	11.58	12.00	.2	.....
July 27.....	N-S.	(?)	Absent.	12.43	12.44	12.52	.4	(?)
	E-W.	(?)	Absent.	12.43	12.44	12.47	.2	.....
Nov. 2.....	N-S.	1.18	Absent.	1.19	1.19	1.25	1.5	(?)
	E-W.	1.18	Absent.	1.19	1.19	1.23	.5	.....
Nov. 7.....	N-S.	16.47	Absent.	16.49	16.50	17.09	3.0	575
	E-W.	16.47	Absent.	16.48	16.50	17.08	1.0	.....
Nov. 7.....	N-S.	17.32	Absent.	17.34	17.34	18.00	2.5	575
	E-W.	17.32	Absent.	17.34	17.34	17.50	1.0	.....
Nov. 17.....	N-S.	11.34	Absent.	11.37	11.38	11.54	1.0	(?)
	E-W.	11.35	Absent.	(?)	11.38	11.45	.1	.....
Nov. 19.....	N-S.	14.00	Absent.	14.04	14.10	14.33	.8	1,250
	E-W.	14.00	Absent.	(?)	(?)	(?)	.1	.....
Nov. 24.....	N-S.	10.22	Absent.	10.23	10.23	10.24	1.0	225
	E-W.	10.22	Absent.	10.23	10.23	10.24	1.0	.....
Dec. 7.....	N-S.	22.54	Absent.	22.59	22.59	23.13	5.0	1,500
	E-W.	22.54	Absent.	22.59	23.03	23.11	3.0	.....
Dec. 9.....	N-S.	8.36	Absent.	8.39	8.41	9.10	1.5	900
	E-W.	8.36	Absent.	8.40	8.41	9.06	.5	.....
1913.								
Jan. 15.....	N-S.	18.55	Absent.	18.57	19.00	19.41	2.0	550
	E-W.			Record missing, clock stopped.				
Feb. 23.....	N-S.	2.57	Absent.	3.00	2.57	3.15	1.5	750
	E-W.	2.57	Absent.	3.00	3.02	3.08	.2	.....
Mar. 6.....	N-S.	1.48	Absent.	1.49	1.49	1.50	1.5	125
	E-W.	1.48	Absent.	1.49	1.49	1.50	1.0	.....
Mar. 8.....	N-S.	15.55	Absent.	15.59	15.59	16.18	2.5	840
	E-W.	15.56	Absent.	15.59	16.02	16.13	1.0	.....
Mar. 9.....	N-S.	16.02	Absent.	16.03	16.04	16.17	3.0	160
	E-W.	16.02	Absent.	16.03	16.04	16.12	1.0	.....
Mar. 14.....	N-S.	9.05	Absent.	9.16	9.10	10.30	1.5	2,170
	E-W.	9.05	Absent.	9.16	9.16	10.14	1.0	.....
Apr. 12.....	N-S.	6.54	Absent.	6.54	6.54	6.56	1.0	Local.
	E-W.	6.54	Absent.	6.54	6.54	6.55	1.0	.....
Apr. 20.....	N-S.	18.01	Absent.	18.02	18.02	18.11	2.5	250
	E-W.	18.01	Absent.	18.02	18.02	18.10	2.0	.....
Apr. 30.....	N-S.	15.18	Absent.	15.19	15.19	15.21	2.0	90
	E-W.	15.18	Absent.	15.19	15.19	15.21	2.0	.....
May 27.....	N-S.	(?)	Absent.	2.26	2.44	2.58	5.0	(?)
	E-W.	(?)	Absent.	2.26	2.42	2.50	1.5	.....
June 14.....	N-S.	8.42	Absent.	8.49	8.50	9.18	.5	2,300
	E-W.	(?)	Absent.	8.50	8.50	8.53	.1	.....
June 19.....	N-S.	1.23	Absent.	1.24	1.25	1.44	1.5	350
	E-W.	1.23	Absent.	1.24	1.25	1.40	.2	.....
June 26.....	N-S.	5.21	Absent.	5.38	5.39	5.44	1.5	3,500
	E-W.			No record on this instrument.				

NOTES.—Period of pendulum, 25 seconds; magnification, 10; damping, medium. The amplitude indicates half of the complete range of maximum motion. Laska's formula used in computing distances in the case of remote earthquakes (620 miles or more) and Omori's formula for earthquakes less than 620 miles distant.

## HYDROLOGY.

The most important change during the year was the rise in Gatun Lake. On July 1, 1912, the elevation was +31 being due to storage following closing of Gatun spillway sluice gates on April 30, 1912, when lake was +16.5. The level was controlled around +32 by the sluice gates (east (E), center (C), west (W), and cylindrical valve (Cyl.) until August 17, 1912, when all gates were closed, the elevation being +32. The following rise continued until September 30, 1912, reaching elevation +48 when the gates were opened. These fluctuations, as well as those for the balance of the fiscal year, including the regulations of the sluice gates, are shown in plates Nos. 110 and 111. From October 20 to December 18 the level was above +50, causing the water to flow over the temporary crest of the spillway dam. The maximum elevation reached was +56.28 on November 29, 1912. This extreme level was caused more by the formation of a jam, consisting of "floating islands" and driftwood, in front of the dam than by excessive discharge, although the maximum flow for the year occurred at the same time. During the six months of 1913 the level was kept between +48 and +50, as shown by plate No. 111. The gates were closed on June 27, 1913, at elevation +48.22, beginning the rise to final operating level (mean +85). With a normal flow this will be reached about the middle of December, 1913.

The yield of the Chagres River system at Alhajuela, Gamboa, and Gatun for the calendar year 1912 was the second in order of dryness since the American occupation in 1904. Plates Nos. 112, 113, and 114 show mass curves for years 1905, 1908, 1911, 1912, and the mean for show 23-year period at each station. It will be seen that the year 1905 was the dryest year, although the dry-season flow for 1912 was the minimum for all stations. These plates give also the percentage of the 23-year mean for each year shown, as summarized in the following table:

Station.	Calendar year.				
	1905	1908	1911	1912	23-year mean.
Alhajuela.....	59.3	101.6	85.6	82.5	100
Gamboa.....	58.5	104.3	79.5	77.5	100
Gatun.....	62.0	78.3	70.2	66.9	100

Plates Nos. 115 and 116 show discharge duration curves for Alhajuela and Gamboa for calendar year 1912 by days, and also by months, in order of dryness. Plates Nos. 117, 118, and 119 show discharge duration curves for Alhajuela, Gamboa, and Gatun for 23 years by months.

Accompanying Table No. 13 gives maximum, minimum, and mean discharges by months for calendar year 1912 at Alhajuela and Gamboa, also the monthly run-off into Gatun Lake. Table No. 14 gives the same data for period January to June, inclusive, 1913, except for Gamboa, gauging work being discontinued at that station in December, 1912.

## STATION EQUIPMENT AND FIELD WORK.

At Alhajucla the work has consisted of 104 current-meter gaugings on the Chagres River and the keeping of continuous records of river heights. The gaugings have been made to cover the total fluctuations of the river, or from 91.2 to 108.4. There has been practically no change in the cross section of the river at this station, so that the discharge-estimate work has been very satisfactory. The measurements at this station were checked by 18 sets of gaugings on the upper Chagres, Pequeni, and La Puente Rivers, near Vigia. In addition to this work the observer at this station has had charge of gaugings on the Gatuncillo, Chilibre, and Chilibrillo Rivers, on which streams 49, 51, and 19 measurements, respectively, were made.

Regular gauging work at Gamboa was discontinued at the end of 1912, although a few measurements were made on extreme low water and during all freshets of any moment. Eighty-one gaugings were taken, 70 being made up until the end of December, 1912. Continuous water elevations were recorded. The backwater from Gatun Lake was felt appreciably at this station about the 1st of September. Gauging work was further complicated by the filling in of the river channel along the north bank following the gravel excavation of the dry season of 1912. Plate No. 120 shows the changes in the cross section at the cable gauging station. From June to December, 1912, the observer at Gamboa made 35 current-meter gaugings on the Obispo diversion just above the junction with the Chagres. From the 20th of August to the 8th of September, the flow of the Obispo diversion was interrupted by a slide on the east bank of the cut.

Gauge readings were taken twice a day on the Chagres River at Juan Mina, also crest elevations and time of same were taken on the larger freshets.

The discharge of the Gatun spillway was regulated by the sluice gates in the concrete dam, as mentioned above. Ninety-eight current-meter measurements were made during the year, and these were combined with the continuous record of elevations at the spillway water gauge in obtaining discharge estimates. The discharge measurements gave some data on the capacity of the sluice-gate openings, but only for lake elevations around +32 and +49, and many of these did not agree closely, probably due to conditions affecting the inflow, that is, submerged driftwood and other obstructions at entrances. Continuous records of elevation of Gatun Lake were obtained.

Since Gatun Lake was raised to elevation +48 the automatic water gauges at Bohio, Frijoles, San Pablo, Gamboa, and Trinidad have recorded lake levels at the various points. All of these instruments were in operation throughout the fiscal year except the San Pablo register, which was installed on October 5, 1912. Table No. 15 gives maximum, minimum, and mean elevations, by months, from January, 1912, to June, 1913, for all stations on Gatun Lake drainage basin.

Gaugings were made on the following streams tributary to Gatun Lake below Gamboa: Trinidad (35), Siri Grande (31), Siricito (10), Gatun (12), Cano (11), Azules (2), Mandingo (12), Agua Salud (13), Frijoles (13), Frijoles Grande (1), and Frijol (10). Most of this work was done by the field hydrographer. The observers stationed



at Trinidad took weekly gaugings on the Trinidad, Siri, and Siricito until the end of 1912. Table No. 16 gives the water supplied to Gatun Lake by the various tributaries for the months of 1912. This table also attempts to balance the inflow and outflow by the following formula:

Inflow:	Outflow:
Discharge of streams.	Discharge of spillway.
Rainfall on lake surface.	Evaporation loss.
Ground water, included in "Inflow not accounted for."	Seepage, included in "Inflow not accounted for."
Storage decrease.	Storage increase.

A study of this table would seem to indicate that the Gatun Lake basin is subject to very little seepage or other underground losses,

Gaugings were taken on the streams tributary to Miraflores Lake basin as follows: Pedro Miguel (26), Caimitillo (18), Camaron (19), Cocoli (12), and Rio Grande (1).

Daily gauge readings were taken throughout the fiscal year on the following streams mentioned below: Agua Salud, Frijolito, Frijol, Pedro Miguel, Caimitillo, Camaron, and Rio Grande. Maximum gauges were observed on the following streams when visited for daily gauge readings or on gauging work, viz: Chilibre, Agua Salud, Frijolito, Frijol, Obispo diversion, Mandingo, Pedro Miguel, Cocoli, and Gatun River. From these readings monthly discharges were estimated as well as maximum flow on freshets.

#### FRESHETS.

Vigia, Alhajuela, and Gamboa have been used as warning stations during freshet stages of the river. During the river year ended April 30, 1913, there were 17 freshets which had a rise of more than 5 feet at Vigia. The rise in Gatun Lake checked the force of freshet rises at Gamboa. Up until September the average ratio between Gamboa and Vigia rise was 0.73 for 12 freshets, the maximum being 0.82 and the minimum 0.60. For the balance of the river year the average ratio was 0.28 for 5 freshets, the maximum being 0.46 just after the lake had reached elevation +50, and the minimum was 0.14 with the lake at elevation +55. This ratio varies with the rise at Vigia and the elevation of the lake. Special formulæ and curves were used in prediction work for elevations at Gamboa and Gatun. Table No. 17 gives summary of principal freshets for 1912, including maximum momentary discharge at Alhajuela and Gamboa, also 24-hour maximum flow into Gatun Lake. The largest freshet since December, 1910, occurred on November 28 and 29, 1912, and is included in above-mentioned table. Table No. 18 gives complete data on slopes of the Chagres River during various stages of this flood. Plate No. 121 shows the profiles of water surface for freshets of December, 1909, December, 1910, and November, 1912, also low water 1909 and April, 1912, and bottom of river in 1909. This diagram shows clearly the effect of the Gatun Lake in checking these floods. It will also be noticed that the river bottom has been lowered at Gamboa since 1909, due to excavation work and increased velocity due to greater slope.

## SPECIAL WORK.

Studies were continued on the relation between rainfall and run-off for Gatun Lake watershed, Miraflores Lake watershed, and Rio Grande reservoir watershed. Plate No. 122 shows rainfall, run-off, and percentage run-off for Gatun Lake basin for river year 1912-13 by months and accumulated for the year. The following summary gives the percentage run-off at Alhajuela and Gatun for river years 1911-12 and 1912-13, and calendar years 1911 and 1912:

*Table showing percentage of run-off at Alhajuela and Gatun.*

## ALHAJUELA.

Calendar year.	Rainfall.	Run-off.	Percentage run-off.	River year.	Rainfall.	Run-off.	Percentage run-off.
	<i>Inches.</i>	<i>Inches.</i>			<i>Inches.</i>	<i>Inches.</i>	
1911.....	119.51	69.65	58.2	1911-12.....	109.70	58.08	53.0
1912.....	109.87	67.04	61.0	1912-13.....	113.41	72.66	64.1

## GATUN.

Calendar year.	Rainfall.	Run-off, inches.		Percentage run-off.		River year.	Rainfall.	Run-off, inches.		Percentage run-off.	
		Net.	Total.	Net.	Total.			Net.	Total.	Net.	Total.
	<i>Inches.</i>						<i>Inches.</i>				
1911....	98.41	53.67	54.08	54.5	54.9	1911-12..	93.17	47.84	48.73	51.4	52.3
1912....	102.83	51.16	53.17	49.7	51.6	1912-13..	106.09	52.80	56.35	49.8	53.1

Investigation of the currents in Colon Harbor was made by this section during January and February, 1913, and was continued during June, 1913, the work being in progress at this writing. The general scheme followed was to trace the courses taken by floats placed in the water at various points in Limon Bay. A few timber floats were tried at first, but double floats made of copper were used for most of the work. These consisted of two parts connected by a light chain or wire so that the distance between the surface and the submerged float could be varied to suit depth of water, sea, and weather conditions at time of observations. The surface float consisted of a cylindrical air-tight copper can 6 inches in diameter and 20 inches long, having a socket on one end for holding a small mast. The submerged float was made up of two sheet-copper wings, 6 by 48 inches, set one below the other at right angles, in a suitable wooden center post. The surface floats, i. e., submerged float within 8 inches of surface, indicated in general surface currents in the direction of the prevailing winds, while the deeper floats showed undercurrents in the direction of the heavy sea swells when the latter prevailed. The stage of the tide seems to have very little effect on the direction of the currents except in shallow areas along the shores and at times in the shallow sections of the old French canal. The combination of these various forces produces a rather indefinite surging of the waters in the bay and channels, being more violent in time of heavy swells, which stir up the fine silt on the bottom. This material tends to

settle in the deeper areas, especially the channels and slips between the piers, on account of the quieter condition of the deep waters.

Special observations were taken on the current in the canal channel at Gamboa, Juan Grande, and Mamei during rises on the Chagres River of large moment. The maximum velocities recorded were 7.33, 3.05 and 2.05 miles per hour, respectively, during the freshet of November 29, 1912, with the lake elevation +56.

The following diagrams and tables accompany this report:

Plates:

110. Gatun Lake hydrograph June–December, 1912.
111. Gatun Lake hydrograph January–June, 1913.
112. Mass run-off curves, Alhajuela, 1912.
113. Mass run-off curves, Gamboa, 1912.
114. Mass run-off curves, Gatun, 1912.
115. Discharge duration curve, Alhajuela, 1912.
116. Discharge duration curve, Gamboa, 1912.
117. Discharge duration curve, Alhajuela, 23-year period.
118. Discharge duration curve, Gamboa, 23-year period.
119. Discharge duration curve, Gatun, 23-year period.
120. Cross sections, Chagres River at Gamboa.
121. Profiles of Chagres River, low water and freshets.
122. Curves showing rainfall, run-off, and percentage run-off for Gatun Lake watershed for river year 1912–13.

Tables:

13. Monthly discharge of Chagres River, 1912, at Alhajuela, Gamboa, and Gatun.
14. Monthly discharge at Alhajuela and monthly yield at Gatun from January to June, 1913.
15. Maximum, minimum, and mean elevations, by months, at all stations from January, 1912, to June, 1913.
16. Gatun Lake water supply, by months, for 1912.
17. Principal freshets for 1912.
18. Data on slopes of Chagres during freshet of November 28–29, 1912.

TABLE NO. 13.—*Monthly discharge—Chagres River.*

ALHAJUELA.

[Drainage area = 427 square miles.]

Month.	Discharge in second-feet.				Run-off (depth in inches on watershed).
	Maximum.	Minimum.	Mean.	Per square mile.	
January.....	968	560	734	1.72	1.983
February.....	1,360	400	516	1.21	1.305
March.....	500	320	382	.89	1.031
April.....	2,530	250	371	.87	.970
May.....	25,300	275	1,682	3.94	4.542
June.....	11,890	970	1,857	4.35	4.853
July.....	31,500	1,170	2,592	6.07	6.998
August.....	14,320	1,335	2,580	6.04	6.963
September.....	19,920	1,730	2,853	6.68	7.453
October.....	9,850	1,730	3,040	7.12	8.209
November.....	54,000	2,163	5,541	12.98	14.482
December.....	9,560	2,093	3,058	7.16	8.255
The year.....	54,000	250	2,100	4.92	67.044

TABLE NO. 13.—*Monthly discharge—Chagres River—Continued.*

## GAMBOA.

[Drainage area=559 square miles.]

January.....	1,020	600	801	1.45	1.672
February.....	1,400	400	542	.97	1.045
March.....	470	320	366	.66	.755
April.....	1,940	250	372	.67	.743
May.....	22,900	260	1,777	3.18	3.666
June.....	11,600	1,145	2,161	3.87	4.319
July.....	30,940	1,290	3,131	5.60	6.456
August.....	15,400	1,490	3,190	5.71	6.583
September.....	18,180	2,040	3,594	6.43	7.174
October.....	9,400	2,050	4,249	7.60	8.762
November.....	51,300	2,748	6,934	12.40	13.935
December.....	7,900	2,265	3,309	5.92	6.825
The year.....	51,300	250	2,536	4.54	61.834

## GATUN LAKE.

[Drainage area=1,320 square miles.]

1. Month.	2. Mean elevation (feet above mean sea level).	3. Area for mean elevation.	4. Spillway discharge.	5. Storage (+increase; —decrease).	6. Evapo- ration from lake surface.	7. Run-off net yield (4+5).	8. Total yield (4+5+6).
		<i>Sq. miles.</i>	<i>Sec.-feet.</i>	<i>Sec.-feet.</i>	<i>Sec.-feet.</i>	<i>Sec.-feet.</i>	<i>Sec.-feet.</i>
January.....	14.38	20.0	1,351	— 106	126	1,245	1,371
February.....	14.42	20.1	310	+ 615	113	925	1,038
March.....	17.07	24.2	000	+ 482	161	482	643
April.....	17.08	24.2	722	— 366	161	356	517
May.....	19.33	28.2	000	+2,692	130	2,692	2,822
June.....	27.48	44.6	1,347	+2,999	131	4,346	4,477
July.....	31.40	52.8	4,945	+ 426	177	5,371	5,548
August.....	33.86	57.6	2,260	+4,420	216	6,700	6,916
September.....	43.64	77.8	61	+7,561	266	7,622	7,888
October.....	49.73	90.0	4,235	+5,955	330	10,190	10,520
November.....	55.51	101.9	12,181	+1,886	306	14,067	14,373
December.....	50.93	92.3	12,840	—7,505	386	5,335	5,721
The year.....	31.24	52.23	3,356	+1,589	208	4,945	5,153

TABLE NO. 14.—*Monthly yield at Alhajuela and Gatun, January to June, 1913: 1912.*

## CHAGRES RIVER AT ALHAJUELA.

[Drainage area, 427 square miles.]

Month.	Year 1913.			1912
	Maximum.	Minimum.	Mean.	Mean.
	<i>Sec.-ft.</i>	<i>Sec.-ft.</i>	<i>Sec.-ft.</i>	<i>Sec.-ft.</i>
January.....	5,260	1,270	1,795	734
February.....	2,770	745	1,177	516
March.....	1,980	535	695	382
April.....	950	380	501	371
May.....	26,300	520	2,051	1,682
June.....	9,120	1,070	1,995	1,857
6 months.....	26,300	380	1,369	924

TABLE NO. 14.—*Monthly yield at Alhajuela and Gatun, January to June, 1913: 1912—Continued.*

## GATUN LAKE WATERSHED.

[Drainage area, 1,320 square miles.]

1 Month.	2 Mean elevation.	3 Area for mean elevation.	4 Spillway discharge.	5 Storage (+ increase, — decrease).	6 Evaporation from lake surface.	Yield of watershed.		9 Total yield of watershed for 1912.
						7 Net, 4+5.	8 Total, 4+5+6.	
	<i>Fect.</i>	<i>Sq. miles.</i>	<i>Sec.-fect.</i>	<i>Sec.-fect.</i>	<i>Sec.-fect.</i>	<i>Sec.-fect.</i>	<i>Sec.-fect.</i>	<i>Sec.-fect.</i>
January.....	48.22	87.1	2,542	+ 41	417	2,583	3,000	1,371
February....	48.34	87.3	1,827	—529	580	1,298	1,878	1,038
March.....	48.25	87.2	1 17	+661	651	578	1,329	643
April.....	48.77	87.8	1 15	+552	580	567	1,147	517
May.....	49.06	88.5	5,630	—638	355	4,992	5,347	2,822
June.....	48.61	87.7	4,823	+289	355	5,112	5,467	4,477
6 months.	48.54	87.6	2,476	+ 62	490	2,538	3,028	1,811

<sup>1</sup> Sluice gate leakage, gates closed.TABLE NO. 15.—*Monthly maximum, minimum, and mean elevations for 1912 and to June, 1913.*

Month.	Gatun.			Bohío.			Frijoles.			San Pablo.		
	Maxi-mum.	Mini-mum.	Mean.	Maxi-mum.	Mini-mum.	Mean.	Maxi-mum.	Mini-mum.	Mean.	Maxi-mum.	Mini-mum.	Mean.
1912.												
January.....	15.48	13.50	14.38	15.50	13.50	14.45	.....	.....	.....	.....	.....	.....
February.....	16.05	13.10	14.42	16.05	13.10	14.44	.....	.....	.....	.....	.....	.....
March.....	17.84	16.05	17.07	17.95	16.05	17.17	.....	.....	.....	.....	.....	.....
April.....	17.90	16.46	17.08	18.00	16.55	17.16	17.81	16.55	16.98	.....	.....	.....
May.....	24.68	16.55	19.33	24.70	16.65	19.43	24.67	16.60	19.46	.....	.....	.....
June.....	30.80	24.68	27.48	30.75	24.70	27.46	30.80	24.67	27.48	.....	.....	.....
July.....	32.85	30.41	31.40	32.75	30.40	31.36	33.88	30.29	31.42	.....	.....	.....
August.....	38.69	31.58	33.86	38.69	31.60	33.82	38.67	31.54	33.87	.....	.....	.....
September....	48.00	38.69	43.64	47.99	38.69	43.65	48.00	38.67	43.71	.....	.....	.....
October.....	54.27	47.75	49.73	54.23	47.74	49.67	54.40	47.74	49.75	54.48	47.78	50.01
November.....	56.28	54.27	55.51	56.26	54.23	55.46	56.48	54.40	55.57	57.02	54.48	55.58
December.....	56.02	48.23	50.93	55.96	48.19	50.85	56.05	48.29	50.98	56.07	48.26	50.96
Year.....	56.28	13.10	31.24	56.26	13.10	31.24	.....	.....	.....	.....	.....	.....
1913.												
January.....	48.73	47.84	48.22	48.68	47.78	48.18	48.77	47.88	48.26	48.79	47.84	48.23
February.....	48.69	47.78	48.34	48.63	47.76	48.29	48.73	47.82	48.36	48.71	47.82	48.34
March.....	48.55	47.80	48.25	48.49	47.78	48.20	48.59	47.84	48.29	48.57	47.82	48.26
April.....	49.14	48.51	48.77	49.11	48.49	48.72	49.20	48.59	48.81	49.20	48.55	48.78
May.....	49.55	48.43	49.06	49.50	48.38	49.01	49.69	48.48	49.11	49.56	48.48	49.21
June.....	49.46	48.11	48.61	49.38	48.09	48.56	49.50	48.17	48.65	49.43	48.14	48.63

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TABLE NO. 15.—*Monthly maximum, minimum, and mean elevations for 1912 and to June, 1913—Continued.*

Month.	Trinidad.			Gamboa.			Alhajuela.			Vigia.		
	Maxi- mum.	Mini- mum.	Mean.	Maxi- mum.	Mini- mum.	Mean.	Maxi- mum.	Mini- mum.	Mean.	Maxi- mum.	Mini- mum.	Mean.
1912.												
January.....	16.20	14.30	15.27	43.95	43.20	43.54	92.16	91.60	91.86	125.70	125.20	125.46
February.....	16.45	13.85	15.03	44.30	42.85	43.14	92.58	91.35	91.51	126.20	125.00	125.16
March.....	18.20	16.45	17.47	43.00	42.60	42.74	91.50	91.14	91.26	125.10	124.75	124.88
April.....	18.30	16.90	17.49	44.60	42.05	42.40	93.52	91.00	91.22	127.05	124.60	124.79
May.....	25.05	16.90	19.73	52.80	42.10	43.89	101.0	91.05	92.52	138.00	124.65	126.18
June.....	31.00	25.08	27.78	49.40	43.25	44.38	97.50	92.10	92.86	132.80	125.60	126.33
July.....	33.10	30.70	31.67	55.35	43.45	44.92	102.9	92.30	93.28	140.95	125.75	126.95
August.....	38.90	31.90	34.10	50.70	43.70	45.19	98.35	92.46	93.39	134.20	126.00	127.08
September.....	48.25	38.90	43.91	51.70	44.30	46.21	99.80	92.80	93.55	136.00	126.30	127.34
October.....	54.55	48.00	49.98	55.30	47.85	50.04	96.82	92.80	93.68	132.00	126.30	127.51
November.....	56.55	54.55	55.77	61.75	54.70	55.90	108.4	93.14	94.77	150.00	126.90	128.96
December.....	56.30	48.50	51.20	56.40	48.28	51.03	96.70	93.09	93.73	131.95	126.80	127.61
Year.....	56.55	13.85	31.62	61.75	42.05	46.12	108.4	91.00	92.80	150.00	124.60	126.52
1913.												
January.....	48.95	48.10	48.47	49.18	47.91	48.30	94.95	92.40	92.84	129.55	126.15	126.61
February.....	48.95	48.00	48.58	48.72	47.78	48.33	93.56	92.85	92.29	127.50	125.70	126.05
March.....	48.81	48.00	48.51	48.60	47.80	48.24	93.00	91.44	91.66	126.70	125.45	125.62
April.....	49.40	48.81	49.04	49.25	48.51	48.74	92.05	91.20	91.43	125.80	125.30	125.44
May.....	49.82	48.70	49.32	53.65	48.52	49.25	101.8	91.48	92.94	139.60	125.45	126.77
June.....	49.70	48.39	48.87	50.34	48.24	48.74	96.60	92.20	92.82	132.10	125.65	126.41

1 5-30 inclusive.

TABLE NO. 16.—*Gatun Lake water supply, 1912.*

[Values in second-feet. Watershed area, 1,320 square miles.]

Month.	Charges at Gamboa.	Siri River.	Trinidad River.	Gatun River.	Cano River.	Mandingo River.	Agua Salud.	Frijolito River.	Frijoles Grande.	Frijol River.
January.....	801	182	118	142	62	4.6	15	11.5	0.9	12
February.....	542	96	70	100	35	1.4	8	7	.3	5.5
March.....	366	57	44	62	16	1	5	5	.3	2
April.....	372	55.5	30.9	37.2	9.1	.2	2.3	3	.2	.8
May.....	1,777	122	59	128	41	2	5.4	4.3	1.1	3.2
June.....	2,161	336	108	216	74	10	16.3	12.3	2	18.4
July.....	3,131	269	106	286	94	19	32	19	(1)	29
August.....	3,190	640	340	400	225	22	37	16	(1)	36
September.....	3,594	788	244	393	255	50	51	28	(1)	56
October.....	4,249	867	595	650	380	75	66	38	(1)	76
November.....	6,934	985	675	950	500	75	104	100	(1)	134
December.....	3,309	525	380	533	250	20	38	20	(1)	31

Month.	Rain-fall on lake.	Inflow not accounted for.	Storage decrease.	Total.	Discharge of spill-way.	Evaporation.	Storage increase.	Out-flow not accounted for.	Total.
January.....	26	.....	106	1,481	1,351	126	.....	4	1,481
February.....	43	129.8	.....	1,038	310	113	615	.....	1,038
March.....	8	77	.....	643	.....	161	482	.....	643
April.....	53.6	.....	366.4	931.2	722	160.8	.....	48.4	931.2
May.....	275	404	.....	2,822	.....	130	2,692	.....	2,822
June.....	535	988	.....	4,477	1,347	131	2,999	.....	4,477
July.....	515	1,045	.....	5,548	4,945	177	426	.....	5,548
August.....	517	1,493	.....	6,916	2,280	216	4,420	.....	6,916
September.....	726	1,703	.....	7,888	61	266	7,561	.....	7,888
October.....	1,405	2,119	.....	10,520	4,235	330	5,955	.....	10,520
November.....	1,638	2,278	.....	14,373	12,181	306	1,886	.....	14,373
December.....	529	86	7,505	13,226	12,840	386	.....	.....	13,226

1 Gauging work discontinued.

TABLE NO. 17.—Principal freshets of year 1912.

Date of beginning.	Vigia.		Alhajuela.			
	Elevation of crest.	Rise.	Elevation of crest.	Rise.	Hours after Vigia.	Maximum discharge.
		<i>Feet.</i>		<i>Feet.</i>		<i>Cubic feet per second.</i>
May 21.....	138.0	12.1	101.0	8.6	1	25,300
July 2.....	141.0	14.6	102.9	9.7	1	31,500
Nov. 27.....	159.8	8.6	102.4	5.9	1½	28,500
Nov. 28.....	150.0	19.6	108.4	12.3	1	54,000
Nov. 29.....	141.8	7.4	103.7	4.8	1	33,500

Date of beginning.	Gamboa.					
	Elevation of crest. <sup>1</sup>	Rise.	Hours after Vigia.	Per cent of Vigia rise.	Per cent of Alhajuela rise.	Maximum discharge.
		<i>Feet.</i>				<i>Cubic feet per second.</i>
May 21.....	53.6	8.8	4½	73	102	22,900
July 2.....	56.2	10.9	5½	75	112	30,940
Nov. 27.....	58.4	2.2	6	26	37	27,500
Nov. 28.....	62.4	6.4	8	33	52	51,300
Nov. 29.....	59.6	1.0	5½	14	21	29,800

Date.	Gatun Lake.					
	Elevation 24 hours after Gamboa crest.	Rise.	Maximum rise in 24 hours.	Maximum storage in 24 hours.	Maximum discharge in 24 hours.	Yield of watershed in 24 hours.
			<i>Feet.</i>	<i>Second-feet.</i>	<i>Second-feet.</i>	<i>Second-feet.</i>
May 21.....	20.88	0.94	1.02	10,400	( <sup>2</sup> )	10,400
July 2.....	32.85	1.02	1.29	22,200	( <sup>2</sup> )	22,200
Nov. 27.....	55.46	.14	.37	12,150	17,350	29,500
Nov. 28.....	56.28	.65	.84	27,800	23,000	50,800
Nov. 29.....	56.17	( <sup>3</sup> )	( <sup>3</sup> )	.....	24,500	24,500

<sup>1</sup> At Fluviograph.<sup>2</sup> Spillway closed.<sup>3</sup> Stationary.

TABLE NO. 18.—Data on slopes of Chagres River during freshet period of Nov. 28–29, 1912.

Station.	Miles from Gatun.	Elevation at various stations when crest was at—								Maximum elevation.
		Low water.	Vigia, 12.30 p. m.	Alhajuela, 1.30 p. m.	Gamboa, 9 p. m.	San Pablo, 11 p. m.	Frijoles, 1 a. m.	Bohio, 4 p. m.	Gatun, 9 p. m.	
Vigia.....	45.75	125.0	150.0	149.4	136.1	134.55	135.8	133.0	132.05	150.0
Calla Larga.....	40.0	.....	.....	.....	.....	.....	.....	.....	.....	118.4
Alhajuela.....	38.5	91.0	107.5	108.4	101.3	99.6	98.9	97.75	97.0	108.4
Juan Mina.....	34.0	.....	.....	.....	.....	.....	.....	.....	.....	81.0
Gamboa (Fluv).....	27.75	44.0	57.7	58.3	62.45	61.8	60.5	57.9	57.2	62.45
San Pablo.....	20.25	.....	55.7	55.85	56.96	57.02	56.93	56.63	56.43	57.02
Frijoles.....	12.10	.....	55.64	55.67	56.15	56.30	56.33	56.45	56.36	56.33
Bohio.....	10.0	.....	55.37	55.43	55.76	55.89	55.96	56.27	56.25	56.27
Gatun.....	0.0	10.0	55.38	55.4	55.67	55.77	55.87	56.25	56.28	56.28

<sup>1</sup> A above normal on account of another freshet; crest at Vigia, 141.8, 5 a. m., 29th.

## SECTION OF GENERAL SURVEYS.

Assistant Engineer O. E. Malsbury has been in immediate charge of the work under this section since August 1, 1912. From July 1, 1912, to August 1, 1912, Junior Engineer R. C. Jones was in charge of the general survey work, and Junior Engineer O. E. Malsbury in charge of the field work and special surveys for the land department of the Panama Railroad. The following are the principal items of work performed during the year:

Three hundred and thirty lots were staked out.

Surveys were made of the Miraflores Lake watershed, which included the watersheds of the Cocoli and Caimitillo Rivers; Corozal Hospital farm; Darien radio station reservation for the Navy Department; Chagres River from Gamboa to the Zone boundary line to locate gravel banks; and the area in the vicinity of Mount Hope which is proposed for oil storage.

Work performed for the Joint Land Commission includes surveys in connection with the following estates: Alba, Guanabano, Las Cascadas Plantation Co., La Isceca and General Aispuru, Mata Redonda, Palenquillo y Frijol Grande (Linczer-Smith), Bosque, Juan Grande, Cardenas and Lo De Caceras, Juan Diaz Caballero, San Jose, and Guayaval.

Numerous surveys have been made for the department of law. All necessary maps in connection with the surveys have been made.

The boundary line between the city of Panama and the Canal Zone has been run out and monuments located, correcting slight errors found therein.

Sixteen primary and 18 secondary stations on the Isthmus have been repaired and cleared. Canvas banners were placed on the stations, and new targets provided. Ninety-five acres of land were cleared in connection with this work.

An error of 100 meters was found in the recorded distance between triangulation stations Gamboa and Obispo; the recorded distance was 1,093.34; the correct distance is 1,193.34.

Precise level bench marks were reset as follows: No. 5 at Mindi, No. 41 at Miraflores, No. 41A at Miraflores, and No. 35 at Lirio.

Numerous other surveys and miscellaneous work was carried out and completed.

During the year the miles of line run by this section requiring clearing, and not including check line are as follows:

	Miles.
Stadia traverse.....	210.8
Stadia side shots.....	186.1
Transit and chain.....	30.0
Transit, chain and Y-level.....	10.8
Hand level.....	8.8
Total.....	446.5

## MECHANICAL WORK.

The details of the conduct of mechanical work performed in the mechanical division, and elsewhere on the Isthmus, by the commission and the Panama Railroad Co., are covered by report of Lieut. Col. T. C. Dickson, Ordnance Department, United States Army, which is attached hereto as Appendix G.



The efforts to reduce the cost of repair work have continued. The total cost of repairs per service day during the year, compared with the previous year, is given in the following table:

Item of equipment.	Fiscal year 1912.			Fiscal year 1913.		
	Service days.	Total expense.	Average cost per service day.	Service days.	Total expense.	Average cost per service day.
Locomotives.....	65,305	\$559,766.23	\$8.57	72,159	\$593,362.27	\$8.22
Steam shovels.....	20,303	465,883.49	22.95	20,235	551,458.13	27.25
Unloaders.....	3,375	48,773.98	14.45	3,421	43,348.49	12.67
Spreaders.....	2,517	35,846.37	14.24	2,939	36,451.54	12.40
Track shifters.....	1,592	4,415.11	2.77	1,536	4,729.11	3.08
Locomotive cranes.....	7,093	53,822.23	7.59	7,031	42,909.67	6.10
Pile drivers.....	1,902	16,082.02	8.46	1,049	18,125.19	17.28
Unloading plows.....	3,124	7,678.98	2.46	2,839	14,188.08	4.99

Car repairs, 1912, \$807,782.29, or \$0.74\$ per car per working day.

Car repairs, 1913, \$896,109.37, or \$0.84\$ per car per working day.

The total cost of repairs to equipment and the cost per cubic yard during the past year as compared with the previous year are given in the following table:

Item of work.	Fiscal year 1912.			Fiscal year 1913.		
	Amount of work accomplished in cubic yards.	Total cost of repairs.	Cost per cubic yard.	Amount of work accomplished in cubic yards.	Total cost of repairs.	Cost per cubic yard.
Excavation:						
Dry.....	19,459,071	\$1,603,513.19	\$0.0824	16,890,819	\$1,777,836.10	\$0.1053
Wet.....	10,539,628	720,533.24	.0684	13,119,816	818,372.58	.0624
Concrete.....	1,443,570	252,268.92	.1748	760,664	136,328.85	.1792
Sand.....	749,491	140,250.91	.1871	489,509	83,037.17	.1696
Stone.....	1,279,692	251,654.71	.1967	872,063	235,840.53	.2704
Fill:						
Dry.....	3,354,787	145,231.16	.0433	5,163,425	263,064.96	.0509
Wet.....	3,199,127	125,630.82	.0393	214,718	815.85	.0038

The average cost of dry excavation in the central division and of wet excavation in the Atlantic and Pacific divisions, for all work accomplished to June 30, 1913, is as follows:

Division.	Item of work.	Cost per cubic yard.			
		Work.	Plant.	General expenses.	Total.
Central.....	Dry excavation.....	\$0.6159	\$0.0952	\$0.0718	\$0.7829
Atlantic.....	Wet excavation.....	.1645	.0580	.0211	.2436
Pacific.....	do.....	.1763	.0759	.0212	.2734

The average cost of concrete laid in the Atlantic and Pacific divisions to June 30, 1913, is as follows:

Division.	Cost per cubic yard.			
	Work.	Plant.	General expenses.	Total.
Atlantic.....	\$6.0905	\$0.6607	\$0.3189	\$7.0701
Pacific.....	4.6507	.5725	.3404	5.5636

The cost of repairs to the marine equipment of the Isthmian Canal Commission and the Panama Railroad Co. during the fiscal year is shown in the following table:

Item of equipment.	Quantities excavated.	Total cost of repairs.	Cost per cubic yard.	Cost per month per unit.
<b>ATLANTIC DIVISION.</b>				
Seagoing suction dredges:	<i>Cubic yards.</i>			
1. Caribbean.....	2,664,850	\$62,588.39	\$0.0235	\$5,215.70
Dipper dredges:				
2. Mindi.....	333,539	47,592.20	.1427	3,966.02
3. Chagres.....	443,843	33,430.24	.0753	2,785.85
Total.....	777,382	81,022.44	.1042	3,375.93
Ladder dredges:				
4. No. 1.....	356,969	11,230.05	.0315	935.84
5. No. 5.....	271,991	17,403.77	.0640	1,450.31
Total.....	628,960	28,633.82	.0455	1,193.07
Tugs:				
6. Bohio.....		13,048.44		1,087.37
7. Gatun.....		7,595.95		632.99
8. Empire.....		9,207.35		767.28
9. Porto Bello.....		22,623.04		1,885.26
10. Mariner.....		13,414.54		1,117.88
11. De Lesseps.....		799.87		66.65
Total.....		66,689.19		926.24
<b>PACIFIC DIVISION.</b>				
Seagoing suction dredges:				
12. Culebra.....	1,793,488	69,106.41	.0385	5,758.87
Dipper dredges:				
13. Cardenas.....	248,080	35,016.28	.1411	2,918.02
Ladder dredges:				
14. Marnot.....	326,408	20,968.99	.0642	1,747.42
15. Badger.....	1,121,196	23,531.25	.0210	1,960.94
16. Mole.....	122,615	22,397.58	.1826	1,866.46
17. Gopher <sup>1</sup> .....	445,658	21,778.86	.0489	1,814.90
18. Corozal.....	1,340,514	75,048.00	.0560	6,254.00
Total.....	3,356,391	163,724.68	.0488	2,728.74
Tugs:				
19. Cocoli.....		21,461.35		1,788.45
20. Chame.....		5,229.69		435.81
21. Miraflores.....		5,921.12		493.43
22. La Boca.....		10,766.11		897.18
23. Reliance.....		20,137.17		1,678.10
24. Bolivar <sup>2</sup> .....		4,676.38		
Total.....		68,190.82		<sup>3</sup> 1,058.59

<sup>1</sup> Engaged in dredging sand at Chame.

<sup>2</sup> This tug was transferred by the Panama Railroad on June 24, 1913. These expenses were incurred in preparing tug for the service of the commission.

<sup>3</sup> Does not include repairs to tug Bolivar.

## TRAVELING ENGINEER.

Mr. James G. Craig has continued as senior traveling engineer, and since the resignation of Mr. Don E. Irwin, junior traveling engineer, July 8, 1912, he has assumed the duties of the latter in addition to those of his own position. The average number of engines ridden per day has been 14; the average number of inspections has been 18.

The number of Isthmian Canal Commission locomotives put through Gorgona shops for general repairs was 48; Panama Railroad, 10; making a total of 58. Shopped for renewal of defective flues and broken stay bolts, Isthmian Canal Commission, 53; Panama Railroad, 1 in Gorgona and 12 in Cristobal shops; making a total of 66 locomotives receiving repairs of this nature. During the year 4,401 broken stay bolts and 16,807 flues were renewed in various locomotives. The stay bolts have reached a period when renewals will necessarily be very rapid, for the original ones have more than performed their duty. One hundred and fifteen investigations into accidents in which the equipment of the Isthmian Canal Commission and the Panama Railroad was concerned, were attended and reports and recommendations were made thereon.

The Panama Railroad has in main-line service 15 oil-burning locomotives and 1 burning coal. These locomotives are in excellent condition in every particular. Only two engine failures are chargeable against this power during the fiscal year. During the year 66 hostlers passed a satisfactory examination and were promoted to locomotive engineers. Forty-three Isthmian Canal Commission and 14 Panama Railroad locomotives were shopped at various times on account of casualties received in service.

## INSPECTION OF LUBRICANTS AND EQUIPMENT.

Mr. J. E. Johnson has performed the duties of inspector of lubricants and equipment during the year. During the year all lubricants have been obtained under annual contract and lubrication has been generally satisfactory. Comparative cost statement of lubricants and oils used by the Isthmian Canal Commission and the Panama Railroad Co. is given in the following table:

	Isthmian Canal Commission, 1908-9	Isthmian Canal Commission and Panama Railroad.			
		1909-10	1910-11	1911-12	1912-13
Lubricating.....	\$62,014.25	\$88,916.03	\$46,884.29	\$43,027.81	\$37,150.13
Miscellaneous.....	5,304.00	7,511.62	549.12	515.20	1,398.50
Illuminating.....	14,894.50	24,387.02	26,607.63	20,760.03	20,593.79
Gasoline.....	18,380.60	16,750.00	6,000.00	9,993.33	14,125.46
Total.....	100,592.75	137,564.67	80,641.04	75,906.37	73,273.88

1912-13 shows a reduction of 3.59 per cent over 1911-12.

The consumption of lubricants, etc., during the past fiscal year and the cost of same has been as follows:

	Isthmian Canal Commission and Panama Railroad.	
	Consumption, 1912-13 gallons and pounds).	Total cost, 1912-13.
Oils and greases:		
Valve.....	58,863	\$11,478.28
Air cylinder.....	1,640	500.20
Marine engine.....	14,573	4,007.57
Stationary.....	18,440	2,397.20
Locomotive engine.....	42,959	4,725.49
Turbine engine.....	6,021	782.73
Gas engine.....	3,688	624.36
Car.....	50,366	5,036.60
Nonliquid.....	11,448	572.40
Cup grease.....	77,394	4,643.64
Gear grease.....	54,984	1,512.06
Cable oil.....	850	114.75
Cable grease.....	2,745	754.87
Total.....		37,150.13
Miscellaneous, lard.....	2,127	1,398.50
Illuminating:		
Signal.....	2,862	1,261.00
Mineral seal.....	100	18.50
Kerosene.....	156,046	19,320.29
Total.....		20,599.79
Gasoline.....	62,122	14,125.46
Grand total.....		73,273.88

The cost of lubrication of marine equipment has been appreciably reduced by installing reclaiming systems and filters wherever practicable and by using the cheapest class of lubricants that will render satisfactory service. On dredges and other nonself-propelling craft the use of marine engine oil has been discontinued, and stationary and locomotive oils have been substituted. Good results have been obtained issuing monthly competitive sheets to the marine engineers, by placing all marine equipment on a fixed monthly lubricant allowance, and by close supervision. As a result the average cost of lubrication of equipment in service has been lowered during the year from about 75 cents per service day per vessel to about 45 cents per service day.

For tug boats the cost of lubrication per service day was reduced from about 90 cents at the beginning of the year to about 50 cents at the close of the year.

The same methods have been followed in reducing the cost of lubricants consumed on locomotives. Each engineer is on a daily allowance, and comparative sheets are compiled monthly and posted in every office, engine house, and yard office. The cost per service day for lubricating commission locomotives during the year was 8.3 cents per service day, as compared with 11 cents during the previous year, showing a reduction of about 25 per cent.

There has been an appreciable reduction during the year in the cost of lubricating steam shovels. The average cost per day per steam shovel during the year has been 34.8 cents. All stationary and portable equipment has likewise been placed on a monthly allowance, and close supervision has been exercised in regard to the use of lubricants. Comparative monthly tabulations are made and posted, and there has been a substantial reduction in cost per service day during the past year. Supervision has been exercised not only for lubricants, but on equipment as well, such as spreaders and unloaders, with satisfactory results as regards reduced cost. The number of standard hand oilers and oil containers has been reduced. All oilers and containers are marked with their standard number and with the name of the oil contained. No oils or lubricants are requisitioned for unless the same are in accordance with the standard list.

The following is a statement of the fuel consumed by the Isthmian Canal Commission and the Panama Railroad Co. during the year, compared with the three previous years:

	Fiscal year 1909-10.				Fiscal year 1910-11.			
	Coal.	Oil.		Total.	Coal.	Oil.		Total.
		Quan- tity.	Equiv- alent in coal.			Quan- tity.	Equiv- alent in coal.	
	<i>Tons.</i>	<i>Barrels.</i>	<i>Tons.</i>	<i>Tons.</i>	<i>Tons.</i>	<i>Barrels.</i>	<i>Tons.</i>	<i>Tons.</i>
Isthmian Canal Commission..	365,329	463,186	115,797	481,126	364,403	679,928	169,982	534,385
Panama Railroad Co.....	33,390	103,177	25,495	58,885	50,796	104,714	26,178	76,974
Total.....	398,719	566,363	141,292	540,011	415,199	784,642	196,160	611,359

	Fiscal year 1911-12.				Fiscal year 1912-13.			
	Coal.	Oil.		Total.	Coal.	Oil.		Total.
		Quan- tity.	Equiv- alent in coal.			Quan- tity.	Equiv- alent in coal.	
	<i>Tons.</i>	<i>Barrels.</i>	<i>Tons.</i>	<i>Tons.</i>	<i>Tons.</i>	<i>Barrels.</i>	<i>Tons.</i>	<i>Tons.</i>
Isthmian Canal Commission..	356,557	769,921	192,408	538,965	343,853	777,604	194,401	538,254
Panama Railroad Co.....	44,828	106,404	26,601	71,429	27,911	127,313	31,828	59,739
Total.....	401,385	876,325	219,009	610,394	371,764	904,917	226,229	597,993

NOTE.—Four barrels of oil assumed to equal 1 ton of coal. Reduction for the fiscal year ending June 30, 1913, 2.75 per cent, compared with 1911-12.

TABLE A.—Statement of rolling stock owned by the Isthmian Canal Commission in use by the different departments as of July 1, 1913.

Description.	Contractors.	Atlantic division.	Central division.	Second division.	Fifth division.	Panama R. R.	Office Chief of Engineers.	Department store.	Disbursing officer.	Mechanical division.	Fortifications.	First division.	Total.
<b>Cars:</b>													
50-ton steel flats.....	12	13	63	...	25	376	...	...	...	3	5	3	500
40-ton wood flats (Lidgerwoods).....		78	1,531	...	25	115	...	...	...	10	3	7	1,769
Narrow-gauge flats—													
3-foot gauge.....		38	...	...	27	...	...	...	...	...	...	...	67
Decauville ½-meter gauge.....		56	25	...	143	27	45	...	...	...	164	...	460
12-yard Western, dump.....		6	188	48	238	31	3	...	...	...	55	21	590
18-yard Western, dump.....		7	135	12	102	5	...	...	...	...	29	5	295
2-yard Western, dump.....		...	...	...	...	...	...	...	...	...	20	...	20
4-yard dump, 3-foot gauge.....		35	...	...	...	...	...	...	...	...	7	...	42
6-yard dump, 3½-foot gauge.....		...	...	...	...	...	31	...	...	...	...	...	31
12-yard Oliver dump.....		...	196	...	349	26	...	...	...	...	20	3	594
18-yard Oliver dump.....		178	18	...	69	...	...	...	...	...	33	...	298
Goodwin dump.....		12	...	...	...	...	...	...	...	...	...	...	12
Ingoldsby dump.....		12	...	...	...	...	...	...	...	...	...	...	12
Pay.....		...	...	...	...	...	...	...	1	...	...	...	1
Electroautomatic Railway													
Gatun handling plant.....		45	...	...	...	...	...	...	...	...	...	...	45
<b>Cranes (various).....</b>		13	2	5	10	5	7	...	...	11	2	10	65
<b>Locomotives:</b>													
201 class, American Locomotive Works.....		5	76	2	16	1	...	...	...	...	...	...	100
301 class, Baldwin Locomotive Works.....		3	18	3	13	...	...	...	...	1	2	...	40
400 class.....		8	1	1	1	3	3	...	...	2	...	...	21
500 class.....		3	3	10	14	1	4	...	...	1	4	...	40
600 class.....		...	19	...	1	...	...	...	...	...	...	...	20
700 class.....		...	1	1	6	1	10	...	...	...	3	...	22
800 class (3 and 3½ foot gauge).....		8	...	...	12	...	8	...	...	...	3	...	31
American, 8-wheel.....		...	2	...	...	...	1	...	...	1	...	...	4
Decauville, ½-meter gauge.....		...	1	...	...	...	2	...	...	4	...	...	7
Special.....		...	...	...	...	...	1	...	...	...	...	...	1
Electrical Industrial Railway													
Gatun handling plant.....		12	...	...	...	...	...	...	...	...	...	...	12
Motor cars.....		1	1	...	1	...	3	...	...	...	...	...	6
Velocipedes.....		...	...	1	2	...	...	...	...	...	...	1	4
<b>Steam shovels:</b>													
Model 20, Marion.....		...	...	...	1	...	...	1	...	...	...	...	6
Model 60, Marion.....		...	...	...	7	...	...	5	...	...	...	...	15
Model 91, Marion.....		3	5	...	...	...	...	...	...	...	...	...	8
45-ton Bucyrus.....		1	1	2	...	1	...	3	...	...	...	...	29
70-ton Bucyrus.....		7	6	...	9	1	...	4	...	...	2	...	30
95-ton Bucyrus.....		...	30	...	...	...	...	...	...	...	...	...	1
Type 1, Thew.....		...	...	...	1	...	...	...	...	...	...	...	26
Spreaders.....		3	12	...	6	2	...	2	...	...	1	...	28
Unloaders.....		2	21	...	2	...	...	2	...	...	1	...	9
Track shifters.....		1	5	...	3	...	...	...	...	...	...	...	11
Pile drivers.....		3	3	...	...	...	...	...	...	...	2	...	...

TABLE B.—Statement of Isthmian Canal Commission floating equipment on the Isthmus as of July 1, 1913.

Description.	Second division.	Sixth division.	Atlantic division.	Quartermaster department.	Department of sanitation.	Department of civil administration.	First division, lights and buoys.	Fortifications.	Total.
Dredges:									
Seagoing suction.....		2							2
Dipper.....		3							3
Ladder.....		7							7
Pipe-line.....		7							7
Clam-shell.....		1							1
Tugs:									
Seagoing.....		9	1						10
Other.....		1							1
Towboats, stern wheel.....				1					1
Clapets.....		11							11
Tenders.....		1			1				2
Launches:									
Steam.....		7	2		1		1		11
Gasoline.....	1	9	1		2	4		2	19
Electric.....		1							1
Barges:									
Single-deck lighters, 110-foot.....		5						1	6
Deck barges—									
75-foot.....		5							5
40-foot.....		3	1						4
Dump barges—									
168-foot.....			4						4
156-foot.....		3	11					2	16
154-foot.....		4							4
150-foot.....			1						1
122-foot.....		3							3
Sand barges, 127.5-foot.....		6							6
Mud scows, 126-foot.....		9							9
Oil barges.....		2							2
House boats.....		2							2
Drill barges.....		2							2
Derrick barges.....			2						2
Wrecking barges.....		1							1
Coal barges, 110-foot.....		2							2
Water barges.....		1							1
Diving barges.....		1							1
Machine barge at shop.....		1							1
Disinfecting barge.....					1				1
Pile drivers.....		2							2
Crane boats.....		1							1
Coal hoist.....		1							1
Rock breakers.....		1							1
Yawl, gasoline.....		1							1

TABLE C.—Statement of equipment owned by the Panama Railroad Co. as of July 1, 1913.

Rolling equipment.	In Panama R. R. service.	In service of Isthmian Canal Commission.						In service of Fortification Board.	Total.
		Atlantic division.	Central division.	Fifth division.	Quartermaster's department.	Mechanical division.	First division.		
Locomotives:									
Road.....	19	7	5	12					43
Switch.....	16	1		1					18
Total.....	35	8	5	13					61
Cars, passenger:									
Special.....	2								2
Parlor.....	2								2
Pay.....	1								1
Coaches, first class.....	21								21
Coaches, second class.....	21								21
Hospital.....	2								2
Baggage and mail.....	8								8
Total.....	61								61
Cars, freight:									
Box.....	898	18	39	14	6	4	1	9	989
Coal.....	37				1	1			39
Flat.....	15		3	2		2		1	23
Fast freight.....	19								19
Local express.....	2								2
Stock.....	20								20
Specie.....	2								2
Total.....	993	18	42	16	7	7	1	10	1,094
Cars, service:									
Caboose.....	15								15
Water (tank).....	3								3
Ballast (Rodger).....	199	1							200
Outfit.....	82					1		2	85
Refrigerator.....	22								22
Total.....	321	1				1		2	325
Miscellaneous:									
Motor car.....	1								1
Steam shovel.....	1								1
Crane, 25-ton.....	1								1
Crane, 10-ton.....	1								1
Cranes, 75-ton.....	2								2
Pile drivers.....	2								2
Ditching machine.....	1								1
Total.....	9								9
Floating equipment:									
Floating pile driver.....	1								1
Cargo lighters.....	8								8
Coal lighters.....	5								5
Launch, gasoline.....	1								1
Pontoon diving apparatus.....	1								1
Rowboats.....	2								2
Total.....	18								18



## OFFICE ENGINEER.

Mr. A. B. Nichols has been in immediate charge, as office engineer, of the general drafting work, the engineering files, and the blue printing of the chief engineer's office. The usual routine work has been accomplished, including the compiling and recording of various statistics, etc., and the making of maps, charts, and diagrams. The general map of the Canal Zone, scale 1:20000, has been completed during the year. The blue-print force turned out about 375,000 square feet of blue print.

Very respectfully,

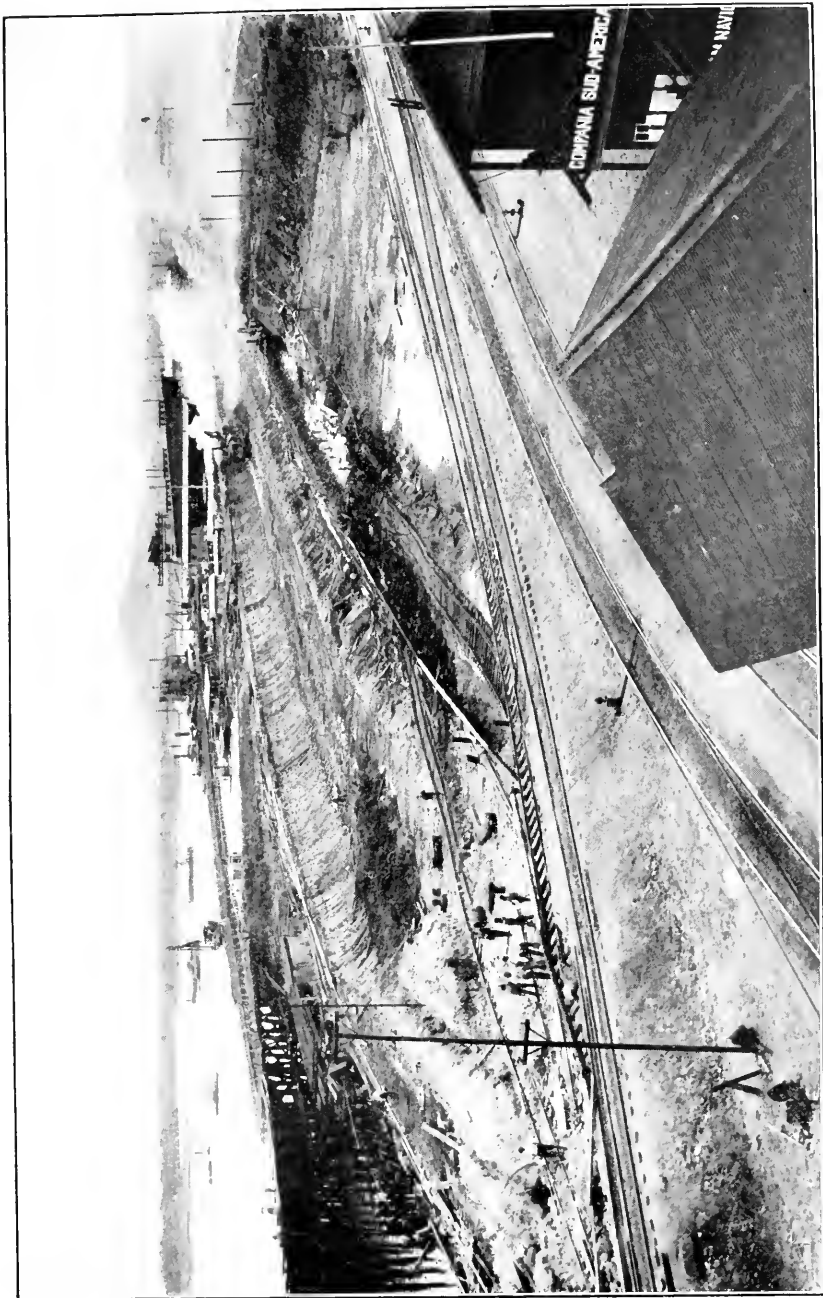
H. H. ROUSSEAU,  
*Civil Engineer, U. S. Navy,*  
*Member, Isthmian Canal Commission,*  
*Assistant to the Chief Engineer.*

Col. GEORGE W. GOETHALS, U. S. Army,  
*Chairman and Chief Engineer*

*Isthmian Canal Commission, Culebra, Canal Zone.*

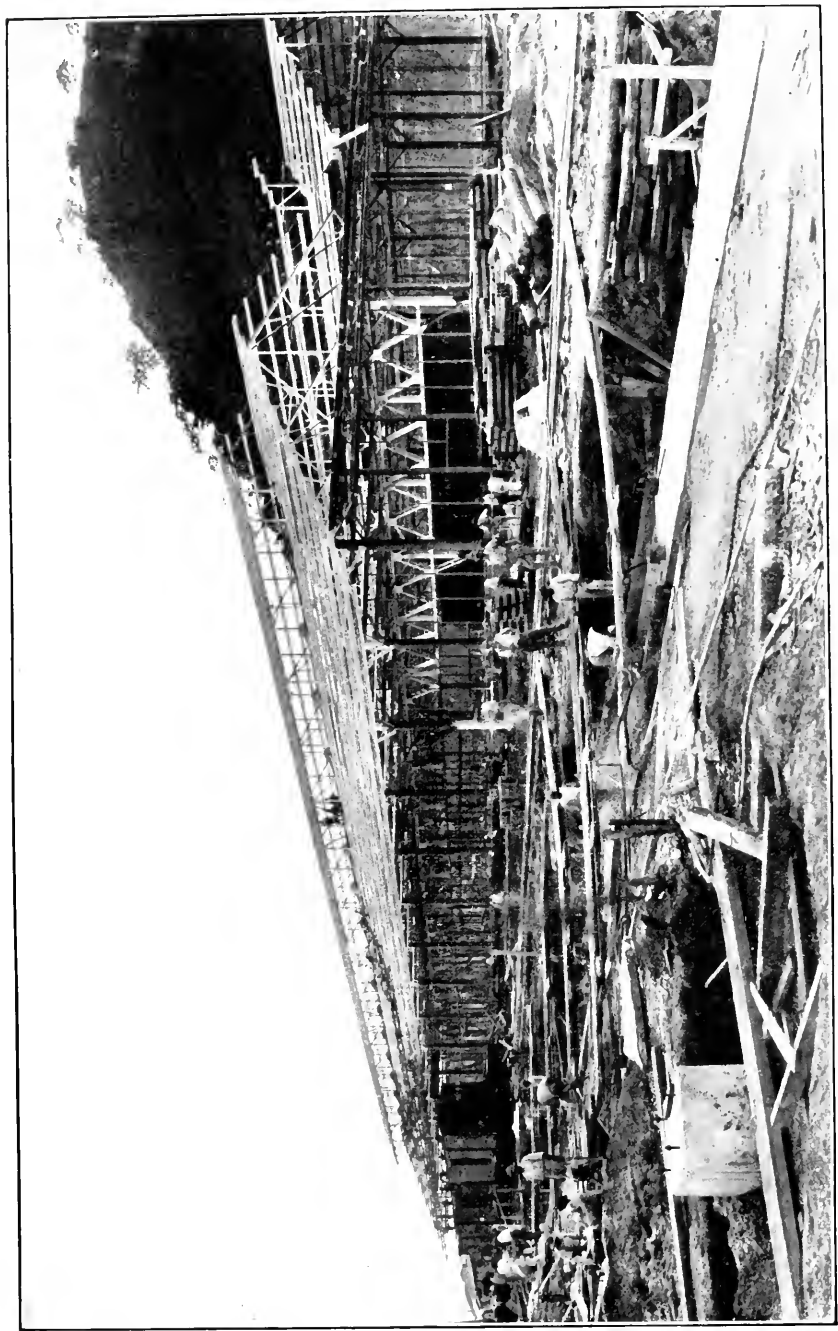
Inclosure: Report of inspector of shops, marked Appendix G.





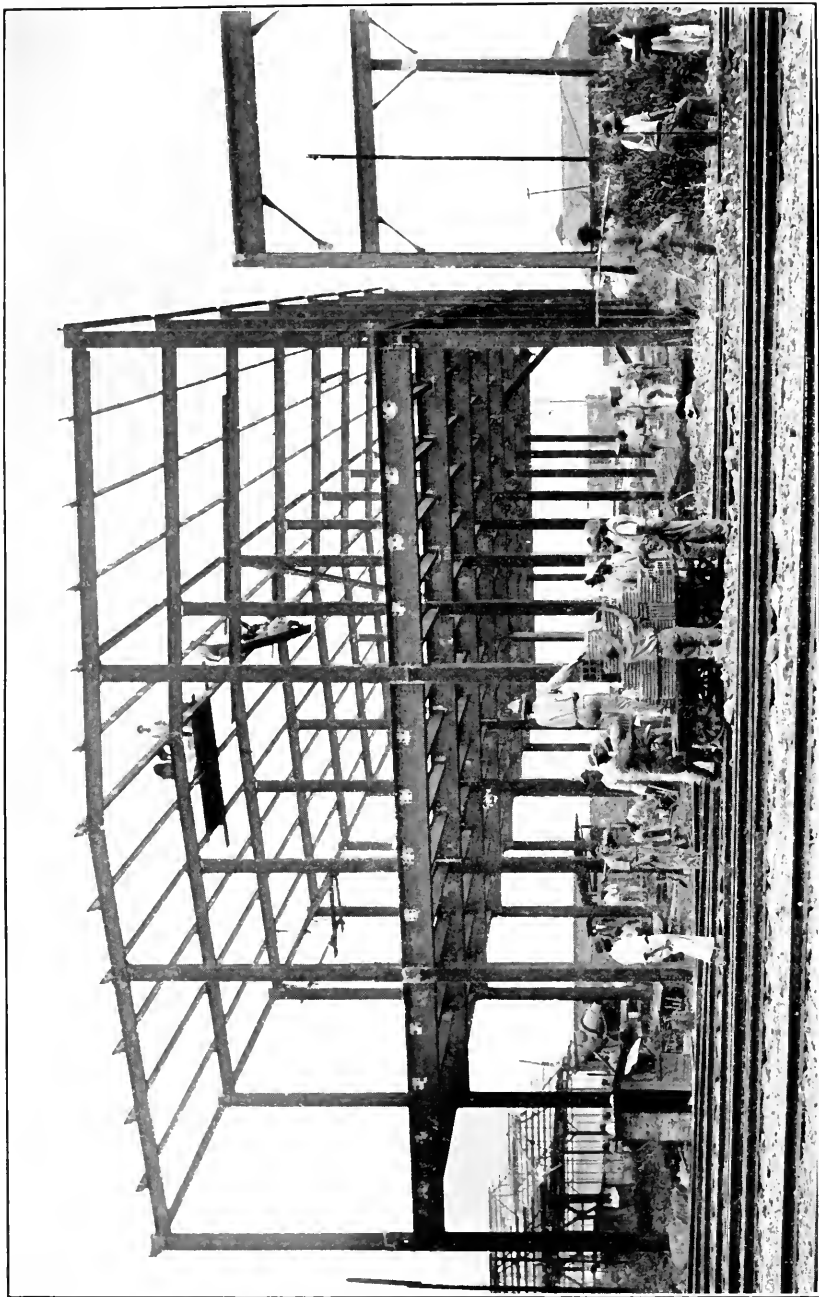
GENERAL VIEW OF EXCAVATION FOR DRY DOCK APPROACH AND COALING PLANT, BALBOA.





BALBOA NEW SHOPS. PLANING MILL, LOOKING EAST, SHOWING OPERATING TUNNEL IN FOREGROUND. JUNE 16, 1913.

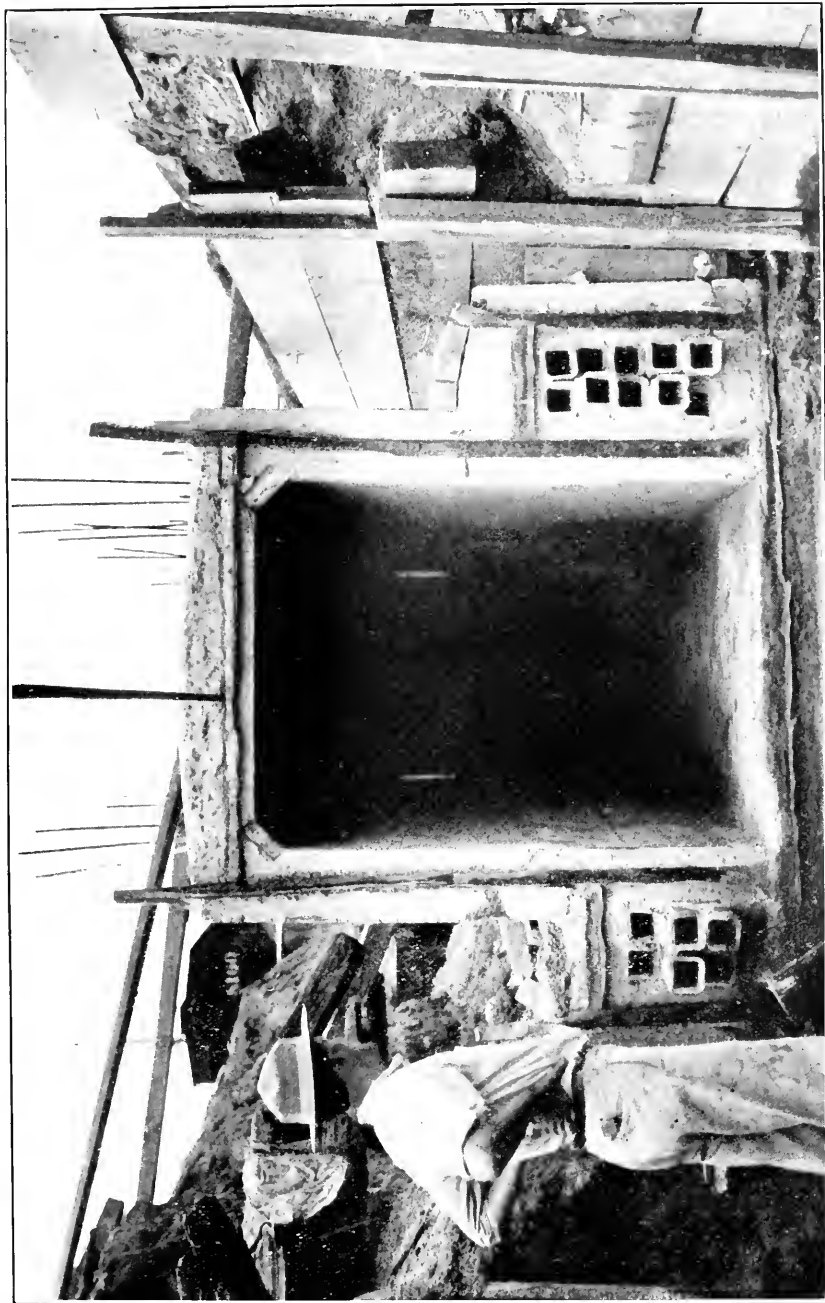




BALBOA NEW SHOPS. PATTERN STORAGE, LOOKING NORTHWEST. FOUNDRY YARD CRANE RUNNING AT RIGHT. PLANNING MILL AT LEFT. JUNE 17, 1913.

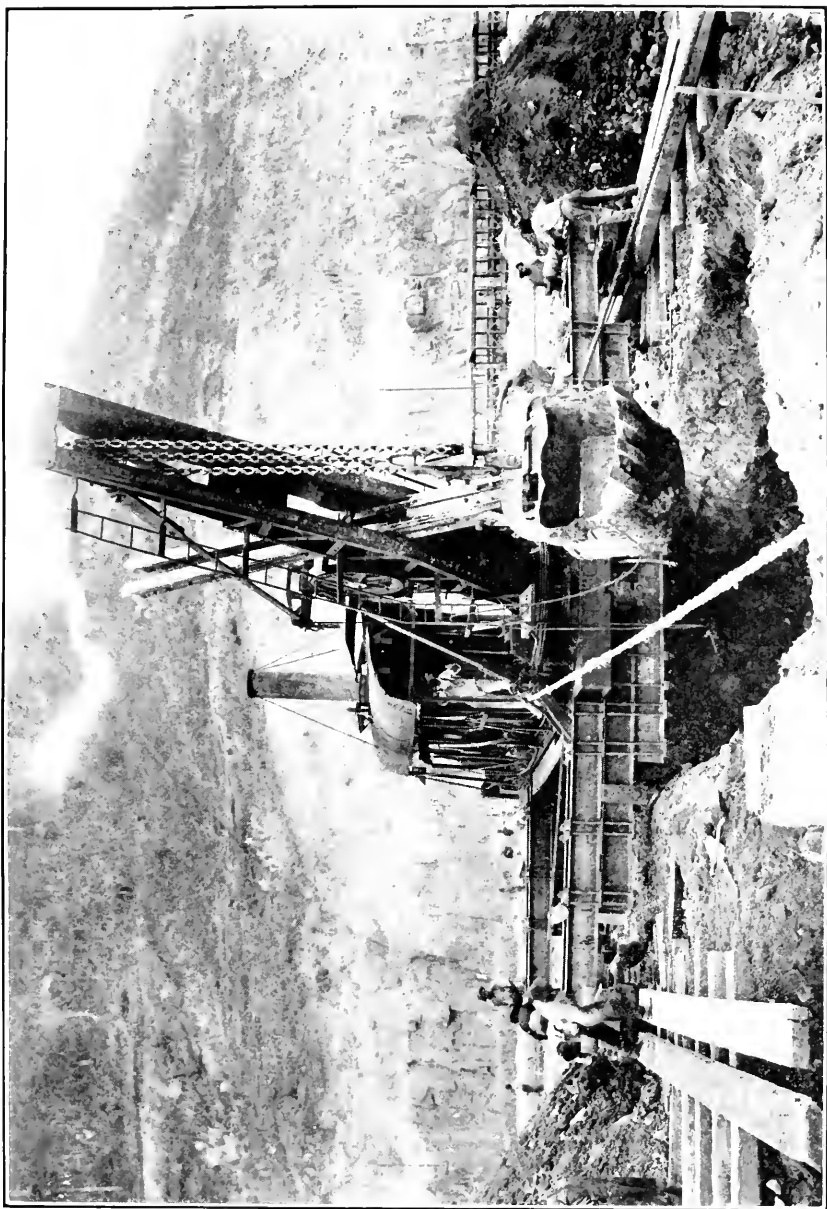






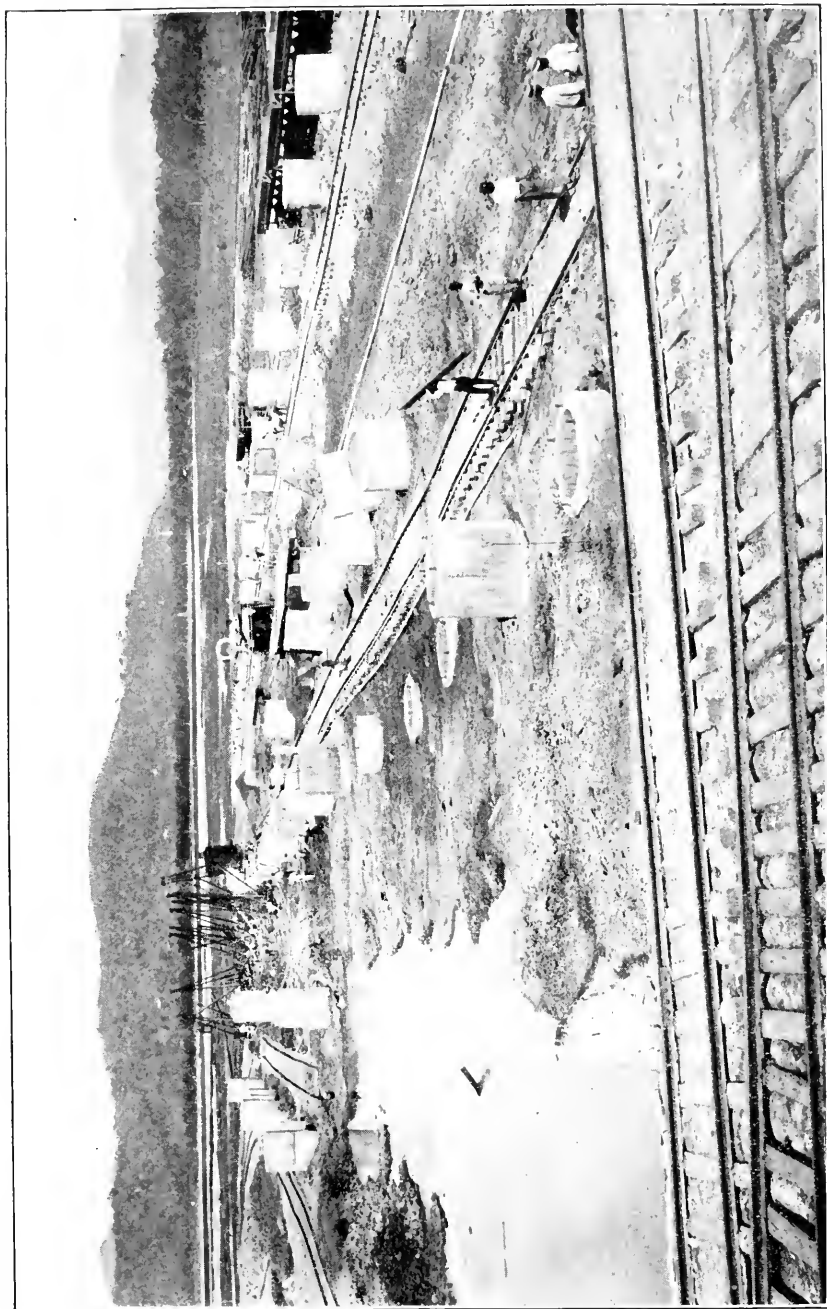
OPERATING TUNNEL, BALBOA SHOPS, FOR PIPES AND CABLES, SHOWING HOW JOINTS IN ADJOINING SECTIONS ARE MADE WATER-TIGHT BY MEANS OF YELLOW METAL STRIPS.





45-TON STEAM SHOVEL ON SKIDS, RIGGED UP TO EXCAVATE FOR CONDUIT TUNNEL, BALBOA SHOPS, "MOVING UP."





REINFORCED CONCRETE CAISSONS FOR PIER NO. 1, BALBOA, TAKEN FROM INSHORE END, LOOKING TOWARD CANAL.





SINKING REINFORCED CONCRETE CAISSONS FOR WHARF AT BALBOA BY  
WEIGHTING THEM WITH CONCRETE AND CAST-IRON BLOCKS.









## APPENDIX G

### REPORT OF LIEUT. COL. T. C. DICKSON, ORDNANCE DEPARTMENT, UNITED STATES ARMY, INSPECTOR OF SHOPS, DEPARTMENT OF CONSTRUCTION AND ENGINEERING.

ISTHMIAN CANAL COMMISSION,  
OFFICE OF THE CHIEF ENGINEER, SECOND DIVISION,  
*Culebra, Canal Zone, July 31, 1913.*

SIR: I have the honor to submit the following report on the work under my jurisdiction during the fiscal year ended June 30, 1913:

The inspections made have included day and night shifts in the different shops and hostling establishments and the principal mechanical apparatus used on construction work; the results thereof, with recommendations, were submitted monthly on form 276-1 C. E. Three hundred and three inspections of shops were made during the year, of which fifty-nine were made at night.

The investigating and recommending action to be taken on requests for transfer of equipment was assigned to me by Circular No. 370D, dated September 27, 1912.

The table following shows for each shop the number of superintendents, general foremen, and foremen constituting the supervisory force, the pay per month of the supervisory force, the number of gold and silver employees, and total number of employees on June 30, 1912, December 31, 1912, and June 30, 1913.

*Number and pay per month of supervisors and number of gold and silver employees and total number of employees in each shop on June 30, 1912, December 31, 1912, and June 30, 1913.*

Shop.	June 30, 1912.				
	Supervisory force.		Number of employees in shop.		
	Number	Pay per month.	Gold.	Silver.	Total.
Dry dock .....	10	\$1,760.60	105	304	409
Porto Bello .....	1	175.00	20	81	101
Spillway and dam .....	2	300.00	3	41	44
Toro Point .....	1	200.00	6	18	24
Car department <sup>1</sup> .....					
Empire .....	12	2,400.00	116	274	390
Gamboa <sup>2</sup> .....	1	200.00	5	16	21
Gatun .....	3	550.00	24	98	122
Gold Hill <sup>3</sup> .....	1	175.00	3	11	14
Gorgona .....	42	7,718.68	743	1,197	1,940
Las Cascadas .....	2	375.00	16	30	46
Pedro Miguel .....	7	1,205.00	61	192	253
Balboa .....	8	1,445.60	63	213	276
Panama Railroad at Cristobal .....	5	865.00	27	311	338
Panama Railroad at Panama .....	1	112.50	1	19	20
Total .....	96	17,482.38	1,193	2,805	3,998

<sup>1</sup> Established May 1, 1913.

<sup>2</sup> Closed Sept. 4, 1912.

<sup>3</sup> Closed between Aug. 12, 1912, and Jan. 3, 1913.

*Number and pay per month of supervisors and number of gold and silver employees and total number of employees in each shop on June 30, 1912, December 31, 1912, and June 30, 1913—Continued.*

Shop.	Dec. 31, 1912.				
	Supervisory force.		Number of employees in shop.		
	Number.	Pay per month.	Gold.	Silver.	Total.
Dry dock.....	8	\$1,420.60	72	162	234
Porto Bello.....	2	220.60	16	84	100
Spillway and dam.....	2	325.00	2	33	35
Toro Point.....	1	200.00	6	18	24
Car department <sup>1</sup> .....					
Empire.....	8	1,700.00	71	172	243
Gamboa <sup>2</sup> .....					
Gatun.....	3	575.00	25	85	110
Gold Hill <sup>3</sup> .....					
Gorgona.....	44	8,151.96	759	1,312	2,071
Las Cascadas.....	2	375.00	15	33	48
Pedro Miguel.....	6	1,060.00	57	183	240
Balboa.....	8	1,470.60	106	433	539
Panama Railroad at Cristobal.....	5	865.00	17	260	277
Panama Railroad at Panama.....	1	112.50	1	19	20
Total.....	90	16,476.26	1,147	2,794	3,941

Shop.	June 30, 1913.				
	Supervisory force.		Number of employees in shop.		
	Number.	Pay per month.	Gold.	Silver.	Total.
Dry dock.....	6	\$1,110.00	68	234	302
Porto Bello.....	2	280.80	18	103	121
Spillway and dam.....	2	350.00	2	14	16
Toro Point.....	1	15.00	7	22	29
Car department <sup>1</sup> .....	12	1,925.00	197	623	820
Empire.....	8	1,700.00	90	271	361
Gamboa <sup>2</sup> .....					
Gatun.....	3	550.00	36	101	137
Gold Hill <sup>3</sup> .....	1	175.00	1	3	4
Gorgona.....	32	6,146.08	757	1,012	1,769
Las Cascadas.....	2	375.00	20	62	82
Pedro Miguel.....	6	1,060.00	70	283	353
Balboa.....	7	1,295.60	87	313	400
Panama Railroad at Cristobal.....	1	225.00	7	49	56
Panama Railroad at Panama.....	1	112.50	1	19	20
Total.....	84	15,479.98	1,361	3,109	4,470

<sup>1</sup> Established May 1, 1913.

<sup>2</sup> Closed Sept. 4, 1912.

<sup>3</sup> Closed between Aug. 12, 1912, and Jan. 3, 1913.

The net decrease in supervisory force in all shops during the year was 12; in monthly pay of supervisors, \$2,002.40. The total force in all shops increased 11.8 per cent during the year.

The total monthly pay roll in each shop during the year, as taken from form 222 C. E., is shown in the following table:

*Total pay roll of each shop and total pay roll of all shops per month during the fiscal year ended June 30, 1913.*

Shop or division.	1912					
	July.	August.	September.	October.	November.	December.
Dry dock.....	\$26,471.98	\$26,735.69	\$25,535.15	\$27,128.67	\$19,210.87	\$19,925.63
Porto Bello.....	3,512.18	3,923.95	2,967.21	3,302.07	3,825.91	3,832.90
Spillway and dam.....	3,292.44	1,990.85	2,149.33	2,295.41	2,208.48	1,463.72
Toro Point.....	1,892.91	2,056.81	1,860.89	1,868.89	1,938.58	2,054.73
Balboa.....	22,117.85	26,264.19	32,208.94	35,020.38	28,802.87	29,813.03
Mechanical division.....	200,736.15	200,756.27	195,930.68	217,244.07	200,314.51	198,251.25
Panama Railroad.....	22,696.15	19,030.95	16,469.10	18,646.35	16,201.20	17,591.20
Total.....	280,719.66	280,758.71	277,121.30	305,505.84	272,502.42	272,932.46

Shop or division.	1913					
	January.	February.	March.	April.	May.	June.
Dry dock.....	\$19,490.04	\$18,899.42	\$18,133.43	\$21,671.87	\$18,165.97	\$17,413.87
Porto Bello.....	4,035.52	3,526.45	4,308.01	4,611.47	4,507.14	4,793.58
Spillway and dam.....	1,740.13	1,590.48	1,535.59	1,985.21	2,752.45	3,471.71
Toro Point.....	2,264.88	2,008.52	1,942.00	1,921.97	2,078.06	1,763.02
Balboa.....	28,740.57	27,788.31	28,816.57	28,520.74	28,948.96	30,952.48
Mechanical division.....	204,982.06	180,250.31	200,349.03	197,811.58	220,918.58	202,956.15
Panama Railroad.....	17,554.35	17,348.10	17,502.70	18,351.90	4,772.05	4,404.65
Total.....	278,807.55	251,411.59	272,587.33	274,874.74	282,143.21	265,755.46

The total pay roll in all shops was \$47,070.59 less than during the previous fiscal year and \$40,890.26 less than during the fiscal year ended June 30, 1911.

The following table shows the cost of overtime work done in all shops for each month during the year:

*Total overtime of each shop and total overtime of all shops per month during the fiscal year ended June 30, 1913.*

Shop or division.	1912					
	July.	August.	September.	October.	November.	December.
Dry dock.....	\$425.01	\$401.36	\$656.77	\$886.58	\$684.00	\$1,573.62
Porto Bello.....	81.09	175.45	97.71	197.76	141.87	81.18
Spillway and dam.....	163.48	42.47	87.74	154.13	202.95	15.37
Toro Point.....	43.90	13.50	55.92	61.09	39.15	53.17
Balboa.....	1,855.46	2,015.73	3,877.86	3,729.64	2,247.09	3,284.96
Mechanical division.....	8,725.39	9,922.53	15,751.91	12,658.02	11,542.28	11,342.20
Panama Railroad.....	240.15	253.98	158.16	262.02	266.55	286.98
Total.....	11,534.48	12,825.02	20,686.07	17,949.29	15,123.89	16,637.48
Percentage overtime to total pay roll.....	4.11	4.05	7.46	5.88	5.55	6.10

*Total overtime of each shop and total overtime of all shops per month during the fiscal year ended June 30, 1913—Continued.*

Shop or division.	1913					
	January.	February.	March.	April.	May.	June.
Dry dock.....	\$1,004.05	\$1,210.49	\$1,834.27	\$3,376.28	\$887.73	\$1,133.08
Porto Bello.....	133.69	88.76	294.52	199.25	387.97	482.64
Spillway and dam.....	26.18	39.68	1.66	32.13	46.23	89.33
Toro Point.....	135.63	60.11	42.38	42.08	29.57	39.03
Balboa.....	2,067.15	2,360.18	3,277.80	2,414.61	2,090.84	4,140.26
Mechanical division.....	13,182.61	14,062.40	14,783.77	9,211.91	11,293.24	10,243.49
Panama Railroad.....	305.34	221.07	545.10	397.92	346.42	286.09
Total.....	16,854.65	18,042.69	20,779.50	15,674.18	15,082.00	16,413.92
Percentage overtime to total pay roll.....	6.05	7.18	7.62	5.70	5.35	6.18

The total amount paid for overtime during the year was \$197,603.17, which was \$43,492.31, or 28.22 per cent, greater than the amount paid for overtime during the previous year.

The overtime constituted 5.96 per cent of the total shop pay roll during the year. In the previous fiscal year this percentage was 4.58, and for the last six months of the fiscal year ended June 30, 1911, it was 3.75.

The increase in overtime was due to the insistence of construction officials that equipment be kept out of service a minimum length of time for repairs and to construction work on the Balboa terminals interfering with repairs to the dredging and towing fleets at the Pacific end. Construction officials order overtime work, the shops having no control over its amount.

The following table shows the shop expense percentage effective in each shop during the year under Circular No. 169-E:

Division or shop.	Shop-expense per cent.			
	May 1, 1912	Aug. 1, 1912	Dec. 1, 1912	Apr. 1, 1913
Mechanical division.....	37.5	40	50	50
Dry dock shop.....	40	40	50	65
Balboa shop.....	40	50	40	25
Porto Bello shop.....	45	50	60	60
Toro Point shop.....	50	45	40	30
Panama Railroad shop.....	30	30	30	130

<sup>1</sup> Shop expense revoked by circular letter of June 12, 1913, on account of transfer of car department to mechanical division of the commission, effective May 1, 1913.

The shop-expense percentage of the mechanical division and of the dry-dock shops is being retained from 10 to 15 per cent above the average to accumulate sufficient reserve for paying leave with pay accumulated by employees until the permanent organization is put into effect.

*Hostling.*—The amount of equipment hostled and cost, exclusive of overhead expense, were as follows:

Month.	Amount.	Direct labor.	Material	Total.	Average cost of direct labor per hostling.
1912.					
July.....	7,232	\$6,439.80	\$1,366.19	\$7,805.99	\$0.8905
August.....	7,281	6,477.24	1,900.06	8,377.30	.9606
September.....	7,314	6,170.78	2,436.07	8,606.85	.844
October.....	7,601	5,710.84	1,681.35	7,392.19	.7513
November.....	7,372	5,546.76	1,879.69	7,426.45	.7524
December.....	7,846	5,299.16	1,412.65	6,711.81	.675
1913.					
January.....	8,059	5,322.62	2,116.05	7,438.67	.6604
February.....	7,271	5,760.84	1,043.85	6,804.69	.792
March.....	7,868	5,420.49	1,209.74	6,630.23	.6889
April.....	7,091	5,589.35	2,166.25	7,755.60	.7882
May.....	7,535	5,814.83	2,237.13	8,051.96	.7717
June.....	6,908	5,349.59	1,304.57	6,654.16	.7744
Total.....	89,378	68,902.30	20,753.60	89,655.90	.....

The average cost of direct labor per hostling for standard-gauge equipment hostled by the mechanical division was \$0.7709, which was \$0.1855, or nearly 20 per cent less than during the previous year. The lowest average cost of direct labor per hostling in a month during the year at any hostling establishment under the mechanical division was \$0.606, at Las Cascadas during the month of December, 1912; this was also the lowest cost since such records have been kept on the Isthmus.

*Cristobal shops.*—Circular No. 349-B transferred the car department of the Panama Railroad Co. to the mechanical division of the commission on May 1, 1913. This consolidated all car inspection and repair work of the commission and Panama Railroad Co., except at Toro Point and Porto Bello.

During the year 445 cars were given general repairs, 462 were given heavy repairs, and 715 were given light repairs in this shop.

The manufacture of steel cylinders for the Cristobal docks of the Panama Railroad Co., which was commenced in October, 1911, was completed in December, 1912, and the force disbanded. The two 72-inch power riveters used on the work were transferred to Gorgona boiler shop.

*Porto Bello, Toro Point, and spillway shops.*—These three small shops continued under the jurisdiction of the division engineer of the Atlantic division.

*Dry-dock shops.*—These shops were operated under the division engineer of the Atlantic division until May 1, 1913, on which date they were transferred to the mechanical division by Circular No. 183-U.

Seventy-seven boats of various kinds were docked during the year. The average daily working force consisted of 80 gold and 230 silver employees. The total expenditures during the year amounted to \$413,051.83, which was \$174,003.74 less than during the previous fiscal year. A 40-horsepower motor was installed in place of the steam engine for driving the machine tools in the carpenter shop.

As a result of an investigation of the amount of work on hand and that anticipated, the division engineer of the Atlantic division approved my recommendation that the night shift be abolished on October 26, 1912.

The average shop expense per month from July to October, both inclusive, was \$10,674.40 and from November to June, both inclusive, was \$7,443.93. The abolishing of the night shift and other economies effected an average saving in shop expense of \$3,230.47 per month.

Mr. C. J. Reilly, general foreman, is in charge of this shop.

*Gatun shop.*—This shop, under the mechanical division, continued without material change throughout the year, except that as construction work in the vicinity decreased the force was correspondingly reduced. The blacksmith shop maintained by the Gatun Locks subdivision was closed in July, 1912, and the work transferred to this shop. Light repairs to the dredges working north of the Gatun Locks are made by this shop. Mr. C. S. Perry, general foreman, is in charge of the shop.

*Gamboa shop.*—This shop continued to hostle engines for the central division until September 4, 1912, when it was permanently abandoned and the locomotives sent to Las Cascadas for hostling and running repairs.

*Gold Hill.*—An outdoor hostling establishment was maintained by the mechanical division at Gold Hill until August 12, 1912, when excavation on the high level was suspended until the dry season; it was reopened on January 3, 1913, and has continued in operation to date. The work done in this place will be transferred to the hostling establishment being erected on Cottontree dump for repairing and hostling the equipment to be kept in service for terracing the east bank of the canal between Gold Hill and Las Cascadas. The engine shed was moved from Gamboa to this place.

*Las Cascadas shop.*—The engine house maintained at this place by the mechanical division has continued to hostle locomotives at the lowest average cost of labor of any hostling establishment on the Isthmus. Mr. J. M. Abston, general foreman, is in immediate charge.

*Pedro Miguel shop.*—The number of locomotives hosted at Pedro Miguel continually increased during the year, on account of the extension of work on the Balboa terminals and increase in dry excavation at the Miraflores Locks.

By changing the working hours of the day shift and sending more cars to Gorgona, it was practicable and economical to abolish the night shift in the car shop at this place on November 30.

This shop is under the charge of Mr. G. J. Gunn, general foreman.

The number of engines hosted at East Balboa dump, which is under the supervision of the general foreman of the Pedro Miguel engine house, increased during the year. To care for the locomotives used in the Balboa terminals by the second division, the installation was approved of a hostling yard, washout pit, and shed at this place. These additional facilities were nearly completed at the end of the year. The machine-shop car for repairing steam shovels was moved from Miraflores to provide facilities for making light repairs, and a foreman was put in charge. After the abandoning of Pedro Miguel engine house in October next all locomotives at the



Pacific end will be hostled at this place until the roundhouse and yards of the permanent shops are ready for use.

*Empire shop.*—As noted in my last annual report, Circular No. 349—A transferred this shop to the mechanical division on July 1, 1912. The work done in this shop during the fiscal year was limited principally to minor repairs to steam shovels and pumps and all repairs to rock drills, track jacks, and drills, etc.

The saving in shop expense that would result from the transfer of this shop to the mechanical division and the transfer of manufacturing work and heavy repairs to Gorgona was estimated to be \$3,900 per month; the average monthly shop expense during the fiscal year was \$4,181.54 less than during the previous fiscal year.

After August, 1912, repairs to steam shovels in the Empire district of the central division during the day were made by mechanics sent from the Empire shop, which reduced the cost of repairs.

Mr. W. H. Bates, superintendent of steam shovel repairs, supervised repairs to all steam shovels. Mr. J. H. Moriarty, general foreman, was in charge of the Empire shops during the year.

*Balboa shop.*—This shop was operated by Mr. W. G. Comber, resident engineer, and the work therein continued throughout the year with little change in quantity or character. The construction of terminal facilities and the dry dock necessarily handicapped the work of this shop, and contracted its available shop and wharf space. The blacksmith shop was moved into the shipways.

*Gorgona shops.*—Upon the resignation of Mr. J. Belt, general foreman of the car department, effective July 8, 1912, the car and locomotive departments were consolidated under general foreman J. J. Eason; Mr. A. O. Herman was appointed assistant general foreman, and put in charge of the car department, and Mr. F. B. Ferebee was appointed assistant general foreman, and put in charge of the foundry, planing mill, carpenter shop, and pattern shop. These changes effected a saving of \$225 per month in supervision.

The principal additional work assigned to these shops during the year consisted of heavy repairs to steam shovels and their parts.

The wrecking outfit maintained by the central division at Las Cascadas was transferred to the mechanical division on July 1, 1912; the outfit was stationed at Gorgona and the crew was used on shop-work when not engaged in wrecking.

The average number of gold employees at work in these shops on the last day of each month during the year was 735 and of silver employees 1,250. The force in this plant was increased 9.8 per cent during the year.

Under the system of inspecting finished work before shipment, which has proved highly advantageous to the shops as well as to construction divisions, 14,490 finished repair and manufacturing jobs were inspected during the year, at an average cost of 27½ cents each; 314 jobs rejected by the inspector for minor errors were accepted without change by construction officials, 578 jobs were passed after completing omitted work or correcting errors, and 200 jobs were finally rejected.

During the year 14,019 orders covering manufacturing work were received and 13,938 were completed, leaving 669 on hand unfinished on June 30, 1913. The increase over the number unfinished on June 30, 1912 (588), being due to the receipt of orders for delivery

of material for use during the period required to transfer work to the permanent plant.

Reduction in quantity of work enabled the night shift in the planing mill to be taken off August 31, 1912. Increase in quantity of work necessitated putting the night shift on again on March 10, 1913.

The output and cost of iron castings for each month during the year is shown in the following table:

Month.	Output (pounds).	Total cost per pound.	Number of patterns made.	Number of castings made.
1912.				
July.....	682,269	\$0.02708	92	13,379
August.....	563,780	.0317	94	21,506
September.....	511,445	.02971	97	18,840
October.....	626,351½	.02859	101	22,118
November.....	610,327	.02964	84	24,307
December.....	539,002	.0323	78	17,700
1913.				
January.....	537,615	.0329	80	17,452
February.....	509,735	.0317	87	13,531
March.....	549,574	.03354	75	16,558
April.....	625,529	.02863	81	15,231
May.....	741,757	.02678	83	16,651
June.....	553,845	.02963	122	12,502
Total.....	7,051,259½	.....	982	209,775

The average total cost per pound during the year was 3.13 cents. Orders estimated to require 440,000 pounds remained unfinished at the end of the year.

The output and cost of steel castings for each month during the year were as follows:

Month.	Output (pounds).	Total cost per pound.	Number of patterns made.	Number of castings made.
1912.				
July.....	38,840	\$0.1143	14	371
August.....	47,902½	.0884	45	693
September.....	25,507½	.10395	10	666
October.....	62,339	.05775	28	536
November.....	65,040½	.0608	36	426
December.....	65,481½	.08494	25	2,077
1913.				
January.....	59,630	.09872	35	2,752
February.....	61,821	.07952	40	2,342
March.....	106,040	.06653	20	2,399
April.....	92,770	.06762	26	3,097
May.....	75,912	.0873	26	2,970
June.....	93,310	.07668	26	4,029
Total.....	794,593¾	.....	331	22,358

The average total cost per pound during the year was 7.84 cents. Orders for 81,127 pounds remained unfinished at the end of the year. The charge to divisions and departments for steel castings was reduced from 10 to 8 cents per pound on April 1, 1913.

The output and cost of brass castings for each month during the year were as follows:

Month.	Output (pounds).	Total cost per pound.	Number of patterns made.	Number of castings made.
1912.				
July.....	19,660 <sup>3</sup> / <sub>4</sub>	\$0. 1783	35	1,377
August.....	19,639	. 18726	23	1,302
September.....	16,849 <sup>1</sup> / <sub>2</sub>	. 21859	33	1,798
October.....	25,310 <sup>1</sup> / <sub>2</sub>	. 167	26	925
November.....	25,905 <sup>3</sup> / <sub>4</sub>	. 1616	30	1,861
December.....	32,743 <sup>1</sup> / <sub>4</sub>	. 18923	21	2,074
1913.				
January.....	32,767 <sup>1</sup> / <sub>2</sub>	. 25837	42	2,045
February.....	33,702	. 20785	35	2,350
March.....	25,443 <sup>1</sup> / <sub>2</sub>	. 22548	45	2,547
April.....	34,433	. 22389	32	2,207
May.....	36,569	. 2299	26	3,097
June.....	17,652	. 15803	23	1,236
Total.....	324,675 <sup>3</sup> / <sub>4</sub>	.....	371	22,819

The average total cost per pound during the year was 20.52 cents. The quartermaster's department increased the cost of copper from 12 to 18 cents per pound on January 1, 1913.

The abandoning of Gorgona shops, necessitated by the filling of Lake Gatun, was started on May 1, 1913, by the transfer of all coach, labor-car, and steel flat-car work—including the paint shop—to the Cristobal shops and of all Lidgerwood flat and steel dump-car repair work to Empire. The instrument-repair shop was transferred to Empire on June 30, 1913. Plans for the transfer of the other classes of work were completed and announced in Circular No. 349-E. The foundry, planing mill, pattern shop, carpenter shop, and oxy-acetylene plant will be transferred to the permanent plant at Balboa; the laboratory to the Balboa power plant; the remaining classes of work will be transferred to Empire shops until the permanent shops at Balboa are ready for occupation.

*Mechanical division.*—At the beginning of the fiscal year this division operated the Gorgona shops, the engine houses, and minor repair shops at Gatun, Las Cascadas, Gamboa, Gold Hill, Pedro Miguel, and Balboa Dump, the air-compressor plants at Las Cascadas, Empire, and Rio Grande, and the electric-light plant at Empire. During the year the Gamboa engine house was abandoned; and the Empire shops on July 1, 1912, the dry-dock shops on May 1, 1913, and the Miraflores power plant and electric work in the fifth division on May 1, 1913, were transferred to it.

Mr. A. L. Robinson was superintendent of the mechanical division throughout the year.

The volume of work performed monthly during the year by the mechanical division is shown by the following abstract of expenditures:

Month.	Labor.	Material.	Services rendered by other divisions and departments.	Total.
1912.				
July.....	\$200,736.15	\$175,672.01	\$12,737.45	\$389,145.61
August.....	200,756.27	169,824.99	12,744.10	383,325.36
September.....	195,930.68	149,261.71	13,483.54	358,675.93
October.....	217,244.07	194,640.40	14,995.67	426,880.14
November.....	200,314.51	165,077.13	15,507.22	380,898.86
December.....	198,251.25	173,379.57	17,385.29	389,016.11
1913.				
January.....	204,982.06	190,386.54	13,924.63	409,293.23
February.....	180,250.31	191,788.15	13,500.06	385,538.52
March.....	200,349.03	192,870.39	12,851.32	406,070.24
April.....	197,811.58	222,567.09	16,432.84	436,811.51
May.....	220,918.58	195,072.84	7,553.36	424,545.78
June.....	202,956.15	176,029.54	15,045.13	394,030.82
Total.....	2,420,500.64	2,196,570.36	166,160.61	4,783,231.61

The number of repairs to locomotives made each month during the year was as follows:

	Running.	Heavy.	Total.
1912.			
July.....	3,277	57	3,334
August.....	3,296	56	3,352
September.....	2,946	47	2,993
October.....	3,009	56	3,065
November.....	3,111	49	3,160
December.....	3,409	42	3,451
1913.			
January.....	3,590	43	3,633
February.....	3,355	35	3,390
March.....	3,418	37	3,455
April.....	3,439	48	3,487
May.....	3,352	35	3,387
June.....	3,044	12	3,056
Total.....	39,246	517	39,763
Average per month.....	3,270.5	43	3,313.5

Cost of repairs to locomotives:

Labor.....	\$459,296.27
Material.....	157,202.84
Total.....	616,499.11

Average cost per month:

Labor.....	38,358.02
Material.....	13,016.90
Total.....	51,374.92

Average cost per locomotive with 314 locomotives in service:

Labor.....	1,221.59
Material.....	414.55
Total.....	1,636.14

In view of the approaching completion of construction work, all locomotives were inspected and the 102 in best condition were placed on a long-service list and the remainder on a short-service list. No repairs were made to locomotives on the latter list except those necessary for safety.

The number of shop and field repairs made to the different classes of cars during the year were as follows:

Equipment.	Number of shop repairs.	Number of field repairs.	Total.
40-ton flat cars.....	15,980	104,483	120,463
Western dump cars.....	3,385	43,380	46,765
Oliver dump cars.....	2,516	46,645	49,161
Goodwin dump cars.....	46	0	46
Ingoldsby dump cars.....	19	2	21
Steel flat cars.....	239	1,139	1,378
Labor cars.....	217	433	650
Miscellaneous.....	218	3,695	3,913
Total.....	22,620	199,777	222,397

The following table shows repairs made during the year to equipment other than locomotives and cars:

Month.	Cranes.	Track-shifters.	Un-loaders.	Spread-ers.	Narrow-gauge loco-motives.	Others.	Total.
<b>1912.</b>							
July.....	13	9	44	26	7	18	117
August.....	7	6	61	25	17	14	130
September.....	10	5	17	17	0	21	70
October.....	16	10	33	34	3	25	121
November.....	19	8	23	34	11	19	114
December.....	14	8	45	35	8	11	121
<b>1913.</b>							
January.....	17	4	46	42	2	11	122
February.....	8	3	53	51	4	10	129
March.....	16	2	34	37	8	10	107
April.....	32	2	44	33	18	16	145
May.....	20	6	15	25	19	11	96
June.....	30	9	8	20	6	9	82
Total.....	202	72	423	379	103	175	1,354

The number of employees on the pay rolls of the mechanical division on the last day of each month was as follows:

Month.	Gold.	Silver.	Total.	Month.	Gold.	Silver.	Total.
<b>1912.</b>				<b>1913.</b>			
July.....	1,048	2,104	3,152	January.....	986	1,851	2,837
August.....	1,192	2,230	3,422	February.....	990	1,872	2,862
September.....	1,146	2,218	3,364	March.....	992	1,846	2,838
October.....	1,153	2,334	3,487	April.....	1,037	2,253	3,290
November.....	1,136	2,137	3,273	May.....	1,081	2,443	3,524
December.....	1,002	1,834	2,836	June.....	990	2,461	3,451
				Average per month.....	1,063	2,132	3,195

The actual shop expense percentage of the mechanical division each month was as follows:

1912:	Per cent.	1913:	Per cent
July.....	48.36	January.....	39.13
August.....	40.41	February.....	38.39
September.....	49.91	March.....	37.32
October.....	44.50	April.....	39.91
November.....	39.68	May.....	36.47
December.....	40.38	June.....	39.83

Circular No. 384 requires that report be made of each case of unsatisfactory work performed, and the following reports in regard to work done by the mechanical division were received during the year, viz:

Six sheaves, made under requisition No. 736, bored  $3\frac{1}{2}$  instead of 4 inches. Complaint unjustified.

Points not properly welded on dogs, made under work requests Nos. A-2025/446, A-2705/6, and No. 3745. Part of complaint justified.

Shore pipe, made under work request No. A-2552, would not telescope. Complaint justified.

Unloader No. 25 not properly repaired. Complaint justified.

Cost of two steel forms for pier shells, made under work request No. P-1931, excessive. Complaint not justified.

Eccentric core hole in spud point, cast under work request No. P-2067. Complaint justified.

Pistons, cast under work requests Nos. P-2137 and P-2199, too hard. Complaint unjustified.

Five justified complaints out of the total number of different articles that were made and the total number of different pieces of equipment that were repaired during the year constitute an excellent record.

The electric-light and air-compressor plants and electrical installations and distributions under the mechanical division were under the charge of Mr. H. Rowe, electrical superintendent.

The operation of the electric-light plants during the year was as follows:

Month.	Mechanical division plants.		Gatun-Cristobal plants, Atlantic division.		Miraflres plant.		Total distributed.
	Output, Kw. hours.	Cost per Kw. hour.	Output, Kw. hours.	Cost per Kw. hour.	Output, Kw. hours.	Cost per Kw. hour.	
1912.							
July.....	436,554	\$0.0316	270,173	\$0.0276	979,390	\$0.0198	1,686,117
August.....	441,328	.0323	287,144	.0219	995,265	.0206	1,723,737
September.....	432,532	.03004	272,529	.0203	837,630	.0209	1,542,691
October.....	415,931	.03322	293,423	.02345	978,090	.0203	1,687,444
November.....	396,969	.033	302,773	.02918	776,500	.0213	1,476,242
December.....	405,701	.03931	297,399	.02376	722,150	.0214	1,425,250
1913.							
January.....	376,815	.04139	285,401	.02232	911,720	.018	1,573,936
February.....	360,051	.03167	257,958	.0191	873,430	.0191	1,491,439
March.....	372,931	.03511	281,565	.02314	909,020	.0185	1,563,516
April.....	379,418	.02106	275,820	.02433	858,570	.0188	1,513,808
May.....	457,823	.01741	269,710	.01289	964,720	.0128	1,692,253
June.....	296,588	.03146	297,845	.01877	811,470	.01826	1,405,903
Total output.....	4,772,641	.....	3,391,740	.....	10,617,955	.....	18,782,336
A verage cost.....	.....	.02953	.....	.02223	.....	.01906	.....

The output and cost of compressed air during the year were as follows, viz:

Month.	Cubic feet.	Cost.	Cost per thousand cubic feet.
1912.			
July.....	745,959,040	\$23,533.89	\$0.03153
August.....	763,241,800	23,604.78	.03092
September.....	699,408,670	20,905.06	.02987
October.....	823,019,150	23,364.99	.02838
November.....	683,624,055	20,468.94	.02994
December.....	695,096,470	21,934.02	.03152
1913.			
January.....	680,424,260	20,488.67	.03099
February.....	627,268,954	21,922.95	.03494
March.....	673,839,330	22,519.10	.03341
April.....	647,672,405	26,588.02	.04105
May.....	696,265,197	28,653.54	.04115
June.....	714,950,536	26,015.36	.0363
Total.....	8,450,769,867	279,999.32	.....
Average per month.....	704,230,823	23,333.28	.03313

The decreased demand for compressed air at the north end of Culebra Cut and the increased demand at Balboa caused the transfer from Las Cascadas of two compressors and three boilers to the Balboa plant. The Las Cascadas plant was closed on November 17, 1912.

Padlocks that were broken or the keys for which had been lost were scrapped; such locks are now repaired or fitted with new keys.

On June 1, 1913, the making up of the pay rolls and the issuing of coupon books and pay certificates in the mechanical division were transferred to the examiner of accounts.

The employment of 257 applicants for work in shops was approved during the year; among these were 88 boilermakers, 73 machinists, and 30 hostlers.

During the year the mechanical division submitted requisitions for the employment by the Washington office of 410 artisans, clerks, and draftsmen, of which 105 were machinists, 90 boilermakers, 51 hostlers, 42 blacksmiths, 33 car carpenters, 25 molders, and 10 clerks.

The meetings of the mechanical committee were continued until abolished by Circular No. 383-B, in May, 1913, when it was considered that the committee had fulfilled the purpose for which it was organized.

Respectfully submitted.

T. C. DICKSON,  
Lieutenant Colonel, Ordnance Department,  
U. S. Army, Inspector of Shops.

Civil Engineer H. H. ROUSSEAU, United States Navy,  
Assistant to the Chief Engineer,  
Isthmian Canal Commission, Culebra, Canal Zone.





## APPENDIX H.

### REPORT OF LIEUT. F. MEARS, UNITED STATES ARMY, CHIEF ENGINEER, PANAMA RAILROAD RELOCATION.

PANAMA RAILROAD CO.,  
OFFICE OF CHIEF ENGINEER,  
*Colon, Panama, June 30, 1913.*

SIR: I have the honor to submit the following report of operations of the relocation, Panama Railroad, during the fiscal year ending June 30, 1913.

The construction of the relocated line was practically completed on May 25, 1912, upon which date the last section of the new line (Gold Hill division) was formally turned over to the Panama Railroad Co., and accepted.

The work accomplished during the year to which this report pertains consisted of riprapping the submerged embankments through the Gatun Lake section, building bascule bridge at Monte Lirio, and installing automatic signals throughout the line.

#### RIPRAPPING SUBMERGED EMBANKMENTS.

Spoil material from the Culebra Cut was furnished in small quantities during the year, and the embankments at mile post 24, mile post 21 (Rio Frijoles), and mile post 20 (Agua Salud), were reenforced by dumping this material along the side slopes, which will soon be submerged. Some of the spoil material was also used to strengthen the large embankment in the Brazo Valley, mile post 12. This work has been carried on by the track department forces under Mr. M. B. Connolly, roadmaster, and very little remains to be done during the coming year.

#### BASCULE BRIDGE, MONTE LIRIO.

A bascule, or bridge movable in a vertical plane, was installed at Bridge 140, Monte Lirio, during the year. Bridge 140 is 317 feet long, and consists of three plate girder spans removed from old Bridge 44 at Barbacoas on the abandoned line. The center span, a 103.6-foot plate girder, was converted into a lift span by the addition of lifting trusses, lifting mechanism, and counterweight. This bridge was designed by the Strauss Bascule Bridge Co., of Chicago, Ill., and is a patented movable bridge of the heel trunnion type. The contract for supplying the necessary material was let to the Penn Bridge Co., of Beaver Falls, Pa., for \$24,390, and the bridge was erected by the bridge department forces of the Panama Railroad Co., under Mr. J. D. Tysinger, a special superintendent being furnished by the contractor.

This bridge provides for an 80-foot width of channel, 45-foot depth of water at normal lake level, and an unobstructed overhead clearance. It gives ships access to the large area of Gatun Lake, which lies east of the railroad and within the Canal Zone boundaries in this section. The attached photograph, plate No. 62, shows this bridge after the lift span has started to open.

A combined operator's house, block office, and interlocking cabin has been constructed on the west side at the south end of the bridge, from which point the telegraph operator on duty can perform all functions of setting signals, opening and closing bridge, etc. The cabin has been built of permanent material, hollow blocks and reinforced concrete being used throughout.

### AUTOMATIC SIGNALS.

During the year automatic signals have been installed from Mindi to Corozal, with the exception of 4.18 miles between Caimito and Gamboa cabin, where the main tracks are not exactly on permanent grade and alignment.

The building of additional tracks between Pedro Miguel and Corozal and abrupt changes in Isthmian Canal Commission traffic through this territory caused the removal of all automatic features between these points in February.

Within the territory between Mindi and Corozal there are now in service 58 automatic and 4 semiautomatic signals, with track circuit controls ranging from 0.48 to 2.78 miles. These signals are three-position of the type shown in plates Nos. 63 and 64, and operate in the upper right-hand quadrant. The current is furnished from gravity and caustic-soda batteries. The night indications are given through red, yellow, and green roundels in the spectacle casting.

There are also in service within this territory 9 power-operated home signals and 13 power-operated train order and manual block signals; these operate two-position from horizontal to vertical only and night indications are red and green. Current is furnished from caustic-soda battery and the controls are actuated by circuit breakers on levers through special apparatus when required.

Power-operated signals are of two types, designated as bottom-post and top-post signals. The bottom-post signal is self-contained, having two compartments with sufficient space to accommodate the relays, battery, and mechanism. The top-post signal is clamped to an existing signal mast and separate shelter must be provided for relays and batteries. Of the 84 power-operated signals in service on the relocated line, 68 are bottom-post and 16 top-post signals.

The general design of apparatus and typical circuit schemes are in accordance with the latest standards and recommendations of the Railway Signal Association of the United States. The usual scheme of control has been carried further in this installation as trains are brought up to all stop aspects, including train-order signals, at limited speed at all times when traffic is operating under normal conditions.

Some deviations were made in aspects from the general practice in the United States in order to simplify both the night and day indications and to meet local conditions peculiar to the Isthmus.

In certain territory where traffic is exceedingly heavy during certain intervals it is possible to inaugurate a manual-block system and

use the automatic signals as an adjunct to this method of handling trains. In this event their most restrictive aspect is limited speed, allowing the spoil trains to follow each other at the minimum spacing.

The entrance of trains to the main track from crossovers and turnouts (other than passing track) is governed by switch indicators; these are miniature signals inclosed within a cast-iron case and stenciled northward and southward.

Interlocking cabins are equipped with a similar device which enables the signalman to know the condition of the main track on either side of his cabin for a certain determined distance.

During the fiscal year manual-block stations equipped with mechanical upper right-hand quadrant-block signals were installed on the relocated line at Caimito, Gamboa Cabin, tower R, Obispo, New Culebra, Gold Hill, Pedro Miguel, Tunnel Dump, and North Cabin.

A high-speed absolute staff system with indicators and master levers was installed between North Cabin and South Cabin for handling traffic through the Miraflores Tunnel.

Interlocking plants were built at Caimito, Pedro Miguel, North Cabin, and South Cabin. The interlocking plant at Corozal was rearranged to accommodate the track and traffic changes made in March. These plants are mechanical, with such electric features as are necessary, and contain 51 active levers. Plans have been approved and material ordered for the installation of interlocking on Gatun River Bridge (No. 140) and the Isthmian Canal Commission connection at Obispo.

Plate 63 shows the type of automatic signal used on single track between stations and plate No. 64 shows automatic signal at end of passing track.

This work has been in charge of Mr. W. H. Fenley, signal engineer, for the past year.

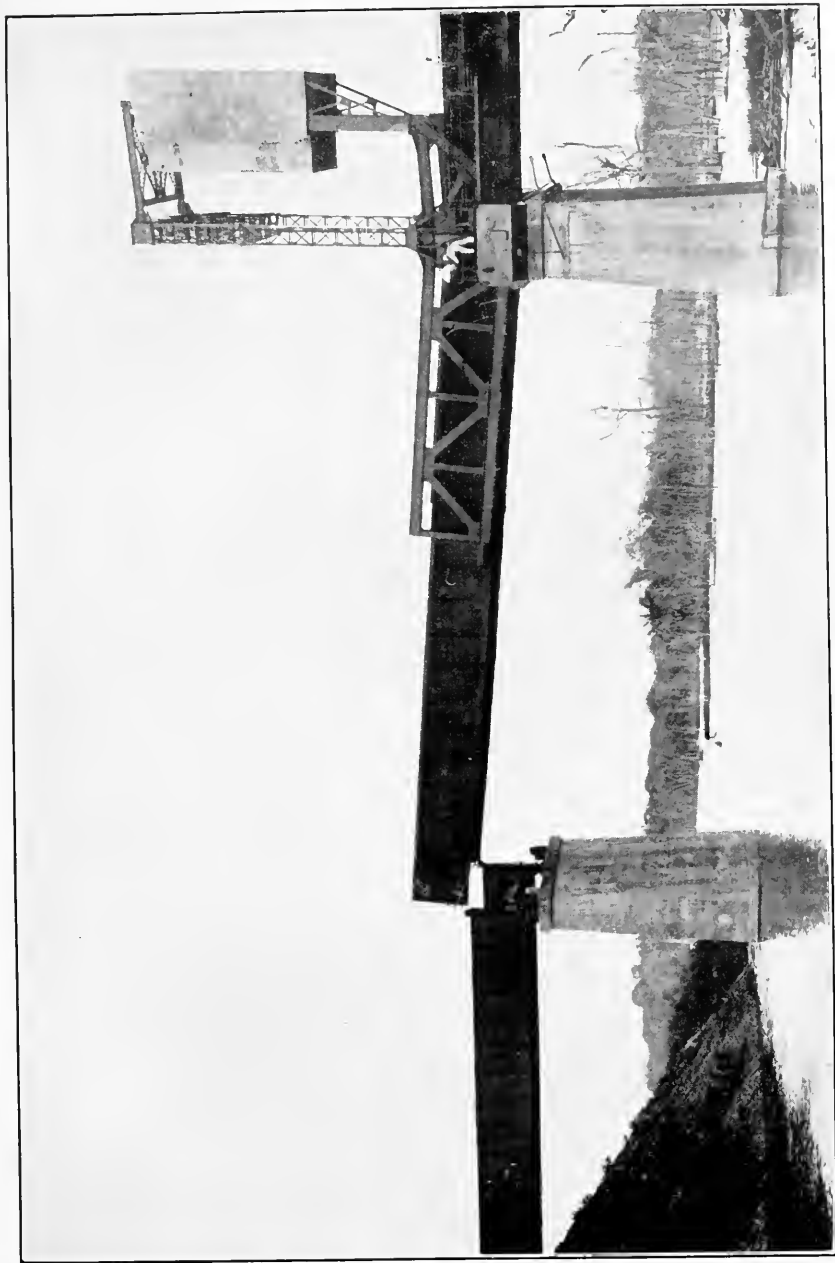
Respectfully submitted.

F. MEARS, *Chief Engineer.*

Col. GEO. W. GOETHALS, U. S. Army,  
*Chairman and Chief Engineer,*

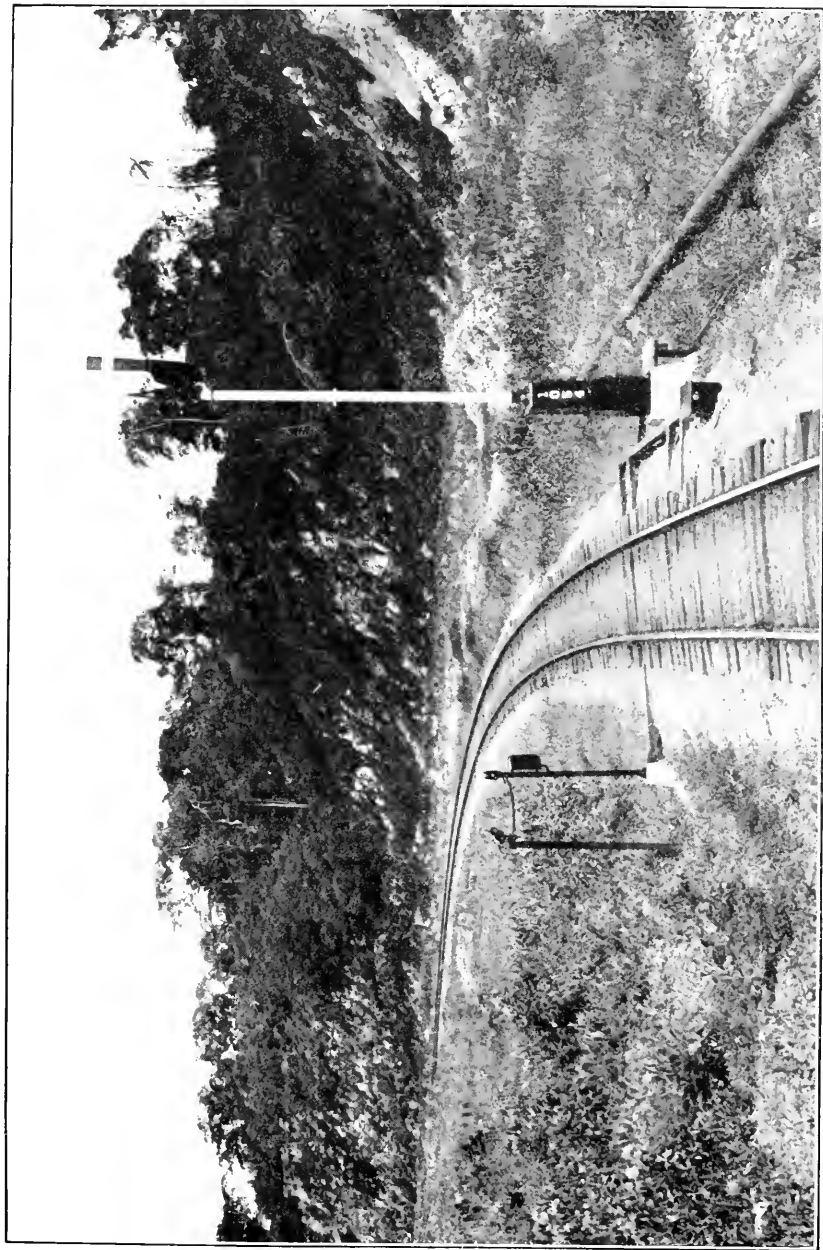
*Isthmian Canal Commission, Culebra, Canal Zone.*





GATUN RIVER BASCULE BRIDGE NO. 140, LOOKING EAST. LIFT SPAN JUST STARTING TO OPEN.

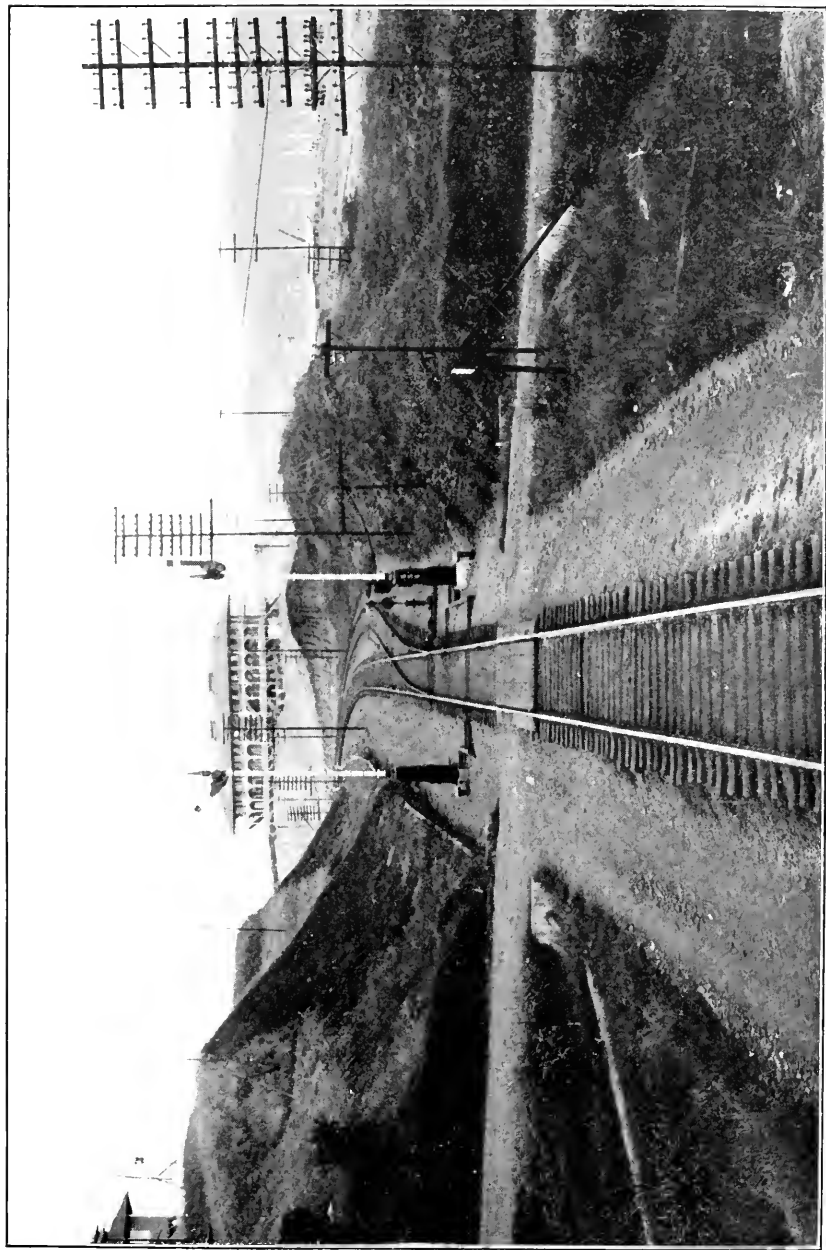




AUTOMATIC SIGNAL NO. 1054, LOOKING NORTH.







AUTOMATIC SIGNALS NOS. 654 AND 655, AT NORTH END OF GATUN PASSING TRACK, LOOKING SOUTH.



## APPENDIX I.

### REPORT OF AD. FAURE, COST-KEEPING ACCOUNTANT IN OFFICE OF CHAIRMAN AND CHIEF ENGINEER.

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ISTHMIAN CANAL COMMISSION,  
OFFICE OF CHAIRMAN AND CHIEF ENGINEER,  
*Culebra, Canal Zone, August 31, 1913.*

SIR: I have the honor to submit the following report for this office for the fiscal year 1913:

At the close of the last fiscal year this office was charged with the supervision of the cost data prepared by the construction divisions and by the engineering department of the Panama Railroad Co., and with the preparation of detailed cost data for the work on the fortifications. On October 1, 1912, the preparation of the detailed cost data for the aids to navigation was transferred to this office. On January 1 the work of preparing the detailed cost data for the reorganized divisions of the former Pacific division was transferred to this office, as was the preparation of the cost data for the first division of the chief engineer's office, which had heretofore been under the supervision of the superintendent of erection, and on April 1, 1913, the Atlantic division accounts were transferred, so that at the close of the fiscal year all the cost accounting for construction work was being done in this office, with the exception of that for the central division.

During the year cost accounts were established for the construction of permanent buildings, the electric transmission line across the Isthmus, and the permanent town sites. The accounts for the construction of terminal facilities were revised, so as to secure the information in more detail, as were those for the work of the first division. For the Panama Railroad cost accounts were established for the construction of a concrete dock at Gatun and of a bridge across the French Canal at Mount Hope to connect with the site of the coaling station. The assistant engineer in charge of fortifications has been furnished cost data in connection with his annual report, as has the chief engineer of the Panama Railroad Co.

With the transfer of the detailed work of cost keeping to this office, 14 employees were transferred, and in spite of the great increase in cost-keeping work (over 60 per cent in May as compared with December) the force was only increased after the close of the fiscal year by two employees. With this increase in force the monthly

expense is \$2,937.50, as compared with an expense of \$3,612.50 for corresponding work at the same time last year.

On account of the various changes in organization since January 1, 1913, the exhibits submitted no longer represent the expenses of the divisions, but rather the expenses in the geographical subdivisions of the canal.

EXHIBIT A. STATEMENT OF CONSTRUCTION EXPENDITURES TO JUNE 30, 1913.

These statements show the total expended to June 30, 1913, for the actual construction of the canal, segregated by construction divisions and by units of work, the division cost (including plant and equipment), and general expenses. The total by divisions follows:

Divisions.	Division cost.		General expenses.		Total.	
	Amount.	Per cent of total.	Amount.	Per cent of total.	Amount.	Per cent of total.
Atlantic.....	\$49,778,393.62	29.15	\$3,727,274.12	25.64	\$53,505,667.74	28.87
Central.....	76,256,181.54	44.65	7,686,337.91	52.88	\$83,942,519.45	45.30
Pacific (including terminals).....	44,207,429.26	25.89	3,097,152.42	21.30	47,304,581.68	25.53
Miscellaneous items of construction.....	537,341.22	.31	25,985.66	.18	563,326.88	.30
Total.....	170,779,345.64	100.00	14,536,750.11	100.00	185,316,095.75	100.00

Included under "Miscellaneous items of construction" are such projects as the aids to navigation, electric transmission line, etc., which can not be charged to any of the geographical divisions of the canal. The construction divisions have but remote control over the "General expenses," details of which appear under Exhibit E; and in this report all comment on costs is based on the division cost. The following table shows by periods the percentage of surcharge over division cost, which has resulted from apportioning the general expenses among the construction divisions:

Divisions.	To June 30, 1909.	Fiscal year—				Total.
		1910	1911	1912	1913	
Atlantic.....	13.34	8.07	6.74	6.70	5.63	7.56
Central.....	12.30	9.54	7.78	7.07	6.49	7.24
Pacific.....	10.99	9.76	7.76	6.07	6.57	10.07
Miscellaneous items of construction.....			19.23	9.04	3.70	5.16
Average.....	12.27	9.08	7.36	6.61	6.24	8.61

The total division cost to the end of the fiscal year 1913 for the various units of canal work was:

## Atlantic division:

## Prism excavation—

Dry.....	\$1, 310, 484. 54
Hydraulic.....	10, 318. 87
Dredging.....	7, 774, 247. 28
Gatun spillway.....	3, 018, 509. 31
Gatun Dam.....	7, 516, 552. 33
Gatun Locks.....	26, 833, 538. 03
Gatun permanent power house.....	344, 281. 09
Gatun, Mindi Levee.....	65, 244. 69
Colon Breakwater.....	2, 885, 063. 23
Clearing drift in Gatun Lake.....	5, 666. 11

Total.....	49, 763, 905. 48
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## Central division:

## Prism excavation—

Dry.....	76, 077, 694. 77
Hydraulic.....	10, 511. 46
Dredging.....	8, 251. 19
Masonry.....	11, 467. 28
Clearing canal line without excavation.....	148, 256. 84

Total.....	76, 256, 181. 54
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## Pacific division:

## Prism excavation—

Dry.....	3, 160, 940. 28
Hydraulic.....	1, 078, 529. 11
Dredging.....	9, 358, 754. 30
Pedro Miguel Dams.....	338, 330. 66
Pedro Miguel Locks.....	10, 645, 321. 55
Miraflores East Dam and spillway.....	728, 374. 54
Miraflores West Dam.....	836, 161. 26
Miraflores Locks.....	14, 879, 535. 73
Miraflores permanent power house.....	146, 561. 86
La Boca Locks and Dams (abandoned).....	565, 684. 33
Naos Island Breakwater.....	384, 540. 89
Temporary electric power plant (balance).....	27, 923. 74
Ancon quarry (balance).....	109, 046. 68
Chame sand plant (balance).....	3, 753. 24

Total.....	42, 263, 458. 17
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## Terminal facilities:

Cristobal.....	14, 488. 14
Balboa.....	1, 943, 971. 09

Total.....	1, 958, 459. 23
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## Miscellaneous:

Permanent town sites.....	52, 458. 77
Permanent buildings.....	61, 191. 95
Aids to navigation.....	377, 041. 63
Electric transmission line.....	14, 597. 23
Trans-Isthmian oil line.....	32, 051. 64

Total.....	537, 341. 22
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Total division expenses.....	170, 779, 345. 64
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## EXHIBIT B. DETAILED COST PER UNIT OF WORK.

TABLE NO. 1. DRY EXCAVATION.

The quantities and average division cost of dry excavation during the fiscal years 1913 and 1912 were:

Nature of work and location.	1913		1912	
	Quantities.	Average division cost.	Quantities.	Average division cost.
Excavation in canal prism:	<i>Cubic yards.</i>		<i>Cubic yards.</i>	
Atlantic division.....			424, 872	\$0.5952
Central division—				
By division forces.....	12, 737, 500	\$0.5525	16, 917, 662	.5115
By contractors.....			145, 784	.3494
Total.....	12, 737, 500	.5525	17, 063, 446	.5101
Pacific division.....	3, 210, 851	.6622	864, 475	.7527
Excavation in spillways, locks, dams, etc.:				
Gatun Locks.....	104, 660	.6041		
Gatun power house.....	14, 948	.4022	72, 119	.3767
Pedro Miguel Dam.....	2, 464	2.8233	3, 937	1.5026
Pedro Miguel Locks.....	3, 044	.4078	95, 156	.3018
Miraflores West Dam.....	9, 923	.5374		
Miraflores Spillway.....	134, 671	1.6101		
Miraflores Locks.....			624, 747	.6566
Preparing foundations for masonry:				
Gatun Spillway.....	175	2.3913	7, 123	2.6400
Gatun Locks.....	33, 063	1.7012	8, 888	2.9598
Gatun power house.....	11, 648	1.7973		
Pedro Miguel Locks.....	15, 366	2.3885	38, 826	2.1715
Miraflores Locks.....	49, 048	2.2356	165, 145	1.5677

With a decrease of 4,180,162 cubic yards in the quantity excavated in the central division by the division forces, the cost per cubic yard increased \$0.0410, principally in the cost of repairs, which increased \$0.0297.

TABLE NO. 2. DREDGING EXCAVATION.

The dredges in service, quantities dredged, and average division cost for operation and repairs during the fiscal years 1913 and 1912 were:

Class of dredge.	1913			1912		
	Number.	Quantity dredged.	Average cost per cubic yard for operation and repair.	Number.	Quantity dredged.	Average cost per cubic yard for operation and repair.
Atlantic division:		<i>Cubic yards.</i>			<i>Cubic yards.</i>	
Seagoing suction.....	1	2, 288, 676	\$0.0579	1	2, 755, 255	\$0.0637
Dipper.....	2	467, 065	.1960	2	595, 667	.2548
French ladder.....	2	628, 960	.1866	2	1, 004, 118	.1562
Pipe-line suction:						
In prism.....	4	3, 098, 707	.0896	2	515, 787	.1129
In Gatun Lock site.....		384, 526	.2400		883, 918	.1749
Pacific division:						
Seagoing suction.....	1	1, 685, 193	.0981	1	2, 376, 505	.0732
Dipper.....	1	227, 981	.3167	1	362, 164	.2143
French ladder.....	3	953, 042	.1602	3	991, 992	.1103
5-yard ladder.....	1	1, 330, 514	.1386	1	153, 626	.2272
Pipe-line suction.....	1	125, 226	.0811			

The above table does not include work done in inner harbor at Balboa, which is commented on under Exhibit C, Table No. 7. In the Atlantic division this year the average cost per cubic yard for pipe lines in connection with the pipe-line suction dredges was \$0.0180 for dredging in prism and \$0.0186 for dredging in Gatun Locks, as against \$0.0127 and \$0.0121, respectively, last year. The charge for retaining dikes was \$0.0002 for dredging in prism this year and \$0.0125 last year. These costs represent the expenses of disposing of material excavated by pipe-line dredges.

The cost of disposing of material excavated by ladder and dipper dredges was: Atlantic division, \$0.1672 per cubic yard, as against \$0.1509 last year; Pacific division, \$0.1092 per cubic yard, as against \$0.0907 last year. In the Atlantic division 753,029 cubic yards of rock were dredged from the prism, being 11.61 per cent of total quantity dredged. The cost of breaking this rock for the dredges was \$0.1536 per cubic yard. Last year there was dredged 574,837 cubic yards of rock, being 11.80 per cent of total quantity dredged, with a cost of \$0.2218 per cubic yard for breaking. In the Pacific division 1,047,929 cubic yards of rock were dredged from the prism, being 24.25 per cent of total quantity dredged. The cost of breaking this rock for the dredges was \$0.3357 per cubic yard. Last year 410,216 cubic yards of rock were dredged, being 10.56 per cent of total quantity dredged, with a cost of \$0.3300 per cubic yard for breaking.

The total quantity of material dredged and the division cost per cubic yard for all dredges, including auxiliary expenses, were:

*Atlantic division.*—In prism, 6,483,408 cubic yards, at an average cost of \$0.2093, in Gatun Locks, 384,526 cubic yards, at an average cost of \$0.4329, as against 4,870,827 cubic yards, average cost \$0.2481, and 883,918 cubic yards, average cost \$0.3129, last year, respectively. The decreased cost was principally due to the larger ratio of excavation by pipe-line suction dredges.

*Pacific division.*—In prism, 4,321,956 cubic yards, at an average cost of \$0.3238, as against 3,884,287 cubic yards last year, at an average cost of \$0.19. The increase is due mainly to the larger ratio of rock excavation and to increased depth of excavation necessitating some dredges working only a portion of the day, owing to heavy tide fluctuations.

TABLE NO. 3. HYDRAULIC EXCAVATION.

The hydraulic plant, formerly operated in the canal prism below Miraflores Locks, was reerected at a point north of Gold Hill to sluice the clay on the top banks. Operations began on June 16, and up to the close of the fiscal year 57,274 cubic yards of material had been removed at a division cost of \$0.1835 per cubic yard, including an arbitrary of \$0.10 per cubic yard for plant. This work is in the Central division, but is being performed by the fifth division, chief engineer's office.

In the Pacific division 451,631 cubic yards of material were removed by hydraulic excavation, at an average division cost of \$1.0113 per cubic yard, including an arbitrary of \$0.7144 per cubic yard for plant, as against 900,596 cubic yards last year, at an average division cost of \$0.5564 per cubic yard, including a charge for plant of \$0.1027 per cubic yard, so that the average operating cost this year was

\$0.2969 per cubic yard, as against \$0.4537 last year. The high charge for plant this year is due to absorbing the balance remaining in the account into a smaller yardage than was originally contemplated. Operations ceased in November, 1912.

TABLE NO. 4. MASONRY.

There was a total of 771,907 cubic yards of masonry laid in the locks, dams, and spillways this year, as against 1,443,570 cubic yards last year, exclusive of the masonry laid by the first division in connection with the installation of machines, etc., and that laid in shop foundations at the Balboa terminals, which appear in another part of this report. The subjoined table shows location, quantities, kind of concrete, and average division cost per cubic yard for the two years:

Location.	1913		1912	
	Quantities.	Unit cost.	Quantities.	Unit cost.
Atlantic division:				
Gatun Spillway—	<i>Cubic yards.</i>		<i>Cubic yards.</i>	
Plain concrete.....	20,653	\$7.8224	58,048	\$7.0133
Reinforced concrete.....	1,066	13.9401	618	15.1631
Total.....	21,719	8.1227	58,666	7.0988
Gatun Locks:				
Plain concrete.....	137,749	6.5383	390,611	7.1317
Reinforced concrete.....	28,100	10.8230	59,883	11.8228
Total.....	165,849	7.2794	450,494	7.7552
Gatun power house.....	5,068	8.5739		
Total Atlantic division.....	192,636	7.4086	509,160	7.6797
Pacific division:				
Pedro Miguel Dam.....	1,567	5.0240		
Pedro Miguel Locks:				
Plain concrete.....	39,465	6.5432	134,193	5.7183
Reinforced concrete.....	18,902	9.7989	48,677	8.5195
Total.....	58,367	7.5976	182,870	6.4640
Miraflores West Dam.....	4,403	4.3330		
Miraflores Spillway:				
Plain concrete.....	63,707	5.7556		
Reinforced concrete.....	435	19.6000		
Total.....	64,142	5.8497		
Miraflores Locks:				
Plain concrete.....	402,607	5.0273	729,096	4.5867
Reinforced concrete.....	48,185	10.8023	22,444	10.6388
Total.....	450,792	5.6445	751,540	4.7675
Total Pacific division.....	579,271	5.8529	934,410	5.0995
Total construction divisions.....	771,907	6.2411	1,443,570	6.0095

There is included in the above table, in this year's quantities, 531 cubic yards of plain concrete used in the installation of tile ducts at Gatun Locks, which were reported last year by the division engineer, Atlantic division.

Plain concrete, with the exception of Gatun Locks, shows increase over last year, due principally to reduced quantities and the use of



a larger ratio of auxiliary mixers. At Gatun Locks, with a decrease in quantity laid of 252,862 cubic yards, there is a decrease in cost of \$0.5934, principally in cost of stone and sand, in the cost of steel forms (none were used this year), and in arbitrary for plant, while there is an increase in the cost of wood forms and of placing. The decrease in the cost of stone is due to readjustment of price, as revised cross section of the stock piles showed more stone in storage than was carried on the books. The decrease in the cost of sand is due to securing sand from the Pacific division and from the borrow pits at Gatun instead of at Nombre de Dios. At Miraflores Locks, with a decrease in quantity laid of 326,489 cubic yards, there is an increase in cost of plain concrete of \$0.4406 per cubic yard, principally in cement \$0.0666, mixing \$0.0301, wood forms \$0.1297, and placing \$0.2172 per cubic yard. The increase in cost of plain concrete placed in Gatun Spillway (\$0.8091) and in the Pedro Miguel Locks (\$0.8249) is accounted for by the relatively small quantity placed this year as compared with the previous year.

There is included in reenforced concrete at Gatun Locks 568 cubic yards, average division cost \$27.2175 per cubic yard, and at Pedro Miguel 205 cubic yards, average division cost \$39.9884 per cubic yard, used in the construction of the control houses at these locks.

The cost of reenforced concrete is shown in detail on table No. 4, and owing to the diversified character of such work explanations of fluctuations would not be of interest.

TABLE NO. 5. DRY FILLING.

The quantities of dry filling placed in the various projects and the average division cost per cubic yard for the fiscal years 1912 and 1913 were:

Nature of work and location.	1913		1912	
	Quantities.	Average division cost, per cubic yard.	Quantities.	Average division cost, per cubic yard.
Atlantic division:	<i>Cu. yds.</i>		<i>Cu. yds.</i>	
Gatun Dam.....	1,812,733	\$0.3551	2,626,447	\$0.5165
Gatun Spillway, back fill.....			10,062	.3898
Gatun Locks—				
Back fill.....	565,756	.3805	922,215	.4615
Center wall fill.....	15,872	.8320	94,574	.7607
Fill at south approach wall.....			7,072	.5092
Pacific division:				
Pedro Miguel Dam.....	114,117	.3312	321,589	.5040
Pedro Miguel Locks—				
Back fill.....	173,938	.4642	349,275	.3535
Center wall fill.....	193,212	.3895	21,937	.9633
Miraflores Dam.....	418,375	.4076	425,125	.4044
Miraflores Locks—				
Back fill.....	979,468	.4068	442,774	.4174
Center wall fill.....	149,301	.5973	7,912	1.0126

Based on the quantities reported monthly, the cost of the dry fill for Gatun Dam shows a decrease of \$0.1614 per cubic yard, principally in the cost of trestles \$0.0034, transportation \$0.0709, filling \$0.0218, and plant arbitrary \$0.0690, no charge appearing this year for the last item, as all plant had been absorbed into the work at the

close of the last fiscal year. The division engineer, however, reports that the dam has been increased during the year by only 1,714,367 cubic yards of dry fill, which would give a division cost for the year of \$0.3755 per cubic yard; and that there was in place at the end of the fiscal year a total of 11,578,268 cubic yards of dry fill, with a division cost of \$4,703,697.35, or \$0.4063 per cubic yard, instead of 11,914,944 cubic yards, at an average cost of \$0.3948 per cubic yard, shown on Exhibit A, Table No. 1.

With a decrease of 356,459 cubic yards in quantity of back fill placed at Gatun Locks, there is a decrease of \$0.0810 in the average cost per cubic yard, principally in tracks and plant arbitrary, no charge appearing for plant this year, it having been previously absorbed. The comparatively small quantity of filling placed in the center wall at Gatun this year as compared with last year accounts for the increase of \$0.0713 per cubic yard.

Filling at Pedro Miguel Dam, with a decrease of 207,472 cubic yards in quantity placed, shows a decrease of \$0.1728 in average cost per cubic yard. This decrease is wholly in charge for plant, which shows reduction of \$0.2608 per cubic yard. At Pedro Miguel Locks, back filling shows a decrease of 175,337 cubic yards, and an increase in cost of \$0.1107 per cubic yard, principally in tracks, transportation, and filling; and filling center wall, with an increase in quantity of 171,275 cubic yards, shows a decrease of \$0.5738, last year having included heavy charges for preparatory work.

At Miraflores, the cost of dry filling the dam and back filling the locks fluctuated but slightly, and the decrease in cost of filling the center wall is due to charges for preparatory work last year, filling having only been started in May, 1912.

TABLE NO. 6. HYDRAULIC FILLING.

Based on quantities reported monthly, there was placed in Gatun Dam 214,718 cubic yards of hydraulic fill, at an average division cost of \$0.2090 per cubic yard, a decrease in quantity of 2,389,914 cubic yards, and in cost of \$0.1754 per cubic yard, due entirely to credits for material recovered on completion of the work in September, 1912. The division engineer, however, reports that the hydraulic fill has been increased during the year by only 169,114 cubic yards, on which basis the cost per cubic yard is \$0.2654; and that there was in place at the close of the fiscal year 10,124,082 cubic yards of hydraulic fill, with a division cost of \$2,969,716.45, so that the cost of hydraulic fill in place at the close of the year is \$0.2933 instead of \$0.2768, as shown in Exhibit A, Table No. 1.

TABLE NO. 8. BREAKWATERS.

During the fiscal year 1913, no filling for the Colon Breakwater was secured from Point Toro, that portion of the work having been completed in June, 1912. There was placed in the breakwater 183,762 cubic yards of large armor rock secured from the Porto Bello quarry, at an average division cost of \$4.8250 per cubic yard. This yardage is the volume of rock in the bank, as it is ascertained by measuring the tonnage displacement of the barges in which it is transported. In 1912, 65,133 cubic yards of this rock was placed in the breakwater, at an average division cost of \$4.3064 per cubic yard. The increased

division cost of \$0.5186 per cubic yard is due to increased expense for placing \$0.2718, and to charging Porto Bello rock with expenses for trestles and for transportation facilities to Point Toro \$0.2986, which had in previous years been charged to the cost of the rock secured from Point Toro.

In the Naos Island Breakwater, the central division placed 653,137 cubic yards of material at an average cost of \$0.2934 per cubic yard, which represents the extra cost of dumping material at that point, and the cost of maintaining the trestle.

TABLE NO. 9. STONE PRODUCTION.

The Ancon quarry alone was operated during the year. The quantity of crushed rock produced and the average cost, during the fiscal years 1913 and 1912, were:

	1913	1912
Crushed stone produced.....cubic yards..	688,301	839,279
Quarrying.....	\$0.5035	\$0.5222
Crushing.....	.1232	.1314
Division expense.....	.0208	.0184
Total cost of production.....	.6475	.6720
Transportation to storage.....	.1320	.1276
Total cost in storage.....	.7795	.7996

With a decrease of 150,978 cubic yards in quantity produced, the average cost of production per cubic yard shows a decrease of \$0.0245 per cubic yard, due to decrease in charge for plant owing to increase in estimates of quantity to be produced, while drilling and blasting in quarry shows increases over last year's costs. Operations at this quarry were begun in February, 1910, and to the end of the fiscal year 1913 had produced 2,558,578 cubic yards of crushed rock, at an average cost of \$0.8572 per cubic yard delivered in storage. It is estimated that about 750,000 cubic yards of crushed rock must still be secured from this quarry. The Porto Bello quarry, which began operation in March, 1909, and closed down in April, 1912, produced 1,921,929 cubic yards of crushed rock at an average division cost of \$2.4337 per cubic yard delivered in storage at Gatun.

TABLE NO. 10. SAND PRODUCTION.

The quantity of sand secured by the Pacific division at Chame, and average cost per cubic yard, for the fiscal years 1913 and 1912, were:

	1913	1912
Quantity of sand secured.....cubic yards..	445,658	564,837
Dredging.....	\$0.1775	\$0.1647
Towing.....	.1758	.1738
Unloading.....	.1845	.1722
Cubic yards transported.....	435,758	564,837
Rail transportation to storage.....	\$0.1733	\$0.1918
Total cost in storage.....	.7111	.7025

With a decrease of 119,179 cubic yards in quantity secured, there was an increase of \$0.0271 in cost of production, due principally to heavier repairs to the dredge, the tugs, and the barges. Dredging for sand at Chame was commenced in September, 1909, and to the close of the fiscal year 1913, 1,741,196 cubic yards had been secured, at an average cost of \$0.7666 per cubic yard delivered in storage. It is estimated that about 125,000 cubic yards must still be secured from this source. The pit at Nombre de Dios, on the Atlantic side, was closed in November, 1911, operations there having commenced in March, 1909. During the period of its operation there was secured 785,893 cubic yards of sand, at an average cost of \$1.9176 per cubic yard delivered in storage at Gatun.

The Atlantic division secured during the year 43,851 cubic yards of sand from the borrow pit for the hydraulic fill at Gatun Dam, at a division cost of \$0.5188 per cubic yard.

TABLE NO. 12. POWER PLANTS.

The power plant at Gatun generated this year 10,315,790 kilowatt hours, at an average division cost of \$0.0146 per kilowatt hour, as against 16,263,510 kilowatt hours last year, at an average division cost of \$0.0220 per kilowatt hour, a decreased cost of \$0.0074 per kilowatt hour, due to lower arbitrary for plant, the estimated output of the plant having been exceeded.

The power plant at Miraflores generated to April 30, when the operation of the plant was transferred to the mechanical division, 8,841,765 kilowatt hours, at an average division cost of \$0.0198 per kilowatt hour. During the same period last year there was generated 7,526,290 kilowatt hours. During the fiscal year 1912 the plant generated 9,522,400 kilowatt hours, at an average division cost of \$0.0229 per kilowatt hour, the decreased cost in 1913 being due to the larger amount generated, and to a reduction of \$0.0018 in charge for plant, owing to output exceeding original estimates.

## EXHIBIT C. DETAILED COST TO JUNE 30, 1913.

These tables show the cost to date of the following projects:

## Work done by first division:

Table No. 1. Spillway gates, caissons, and machinery, lock gates and fender chains, emergency dams, lock-operating machinery.

Table No. 2. Masonry.

Table No. 3. Operating machinery—permanent power house, Gatun.

Table No. 4. Electric transmission line and accessories.

Table No. 5. Lighting and buoying the canal.

## Work done by second division:

Table No. 6. Cristobal terminals.

Table No. 7. Balboa terminals.

## Miscellaneous:

Table No. 8. Permanent town sites.

Table No. 9. Permanent buildings.

The cost of these various projects is being carried from year to year, and these tables give the total costs from the inception of the work to date.

Attention is invited to the heavy charge for construction tracks under "Lock gates, Gatun," as compared with a similar charge at Pedro Miguel and Miraflores. This is in a measure due to the fact

that when the erection of the gates was commenced at the former point the Atlantic division was further advanced with its construction work than was the Pacific division at Pedro Miguel and Miraflores, so that the gates at Gatun bore a heavier proportion of expenses for general tracks than at the other two points, where construction work was at its height.

The items "Mechanical erection" and "Installation" under "Erection of lock and spillway operating machines, etc.," are the direct labor and material costs, exclusive of the contract price of the machines, etc., which is shown as a separate item. Incidental expenses, such as freight charges, handling, power, tools, etc., are included under caption "Miscellaneous expenses." When the work is completed the total cost under each class of machine, divided by the number of machines erected, will give the average cost per machine, but as long as the work is in progress direct labor cost alone is of value, as the contract payments cover more machines than those on which work is in progress, and expenses under "Miscellaneous expenses" are common to machines whose erection has not been started. The number of each class of machines to be erected at each lock and the percentage completed on June 30 is shown in Table No. 4. No machine was completed, tested, and accepted on that date.

The number of linear feet of return track laid by the construction divisions at the various locks and the average cost per linear foot have been as follows: At Gatun 10,527, average cost \$1.3261; at Pedro Miguel 4,333, average cost \$1.1065; at Miraflores 5,925, average cost \$2.5637. The number of linear feet of return track laid by the first division at the various locks and the average cost per linear foot have been: At Gatun 1,449, cost \$1.9273; at Pedro Miguel, 2,043, cost \$2.3678; at Miraflores 1,082, cost \$0.6085.

The number of linear feet of track with rack installed by the first division and the average cost per linear foot have been: At Gatun 21,000, cost \$2.3128; at Pedro Miguel 12,199, cost \$2.0180; at Miraflores 14,137, cost \$1.2291. There was expended at Gatun \$3,480.92 for chipping rack teeth; no similar work was done at the other locks.

The number of linear feet of cable pulled through the conduits at the various locks and the average cost per linear foot for direct labor have been: At Gatun 329,387, cost \$0.0312; at Pedro Miguel 106,168, cost \$0.0596; at Miraflores 59,605, cost \$0.0235.

Concrete laid by the first division in connection with the erection of operating machines, towing tracks, and decking totaled on June 30, 1913, 36,710 cubic yards, as follows: At Gatun Locks 16,706 cubic yards, average division cost \$13.4124 per cubic yard; at Pedro Miguel Locks 10,190 cubic yards, average division cost \$12.1460 per cubic yard; at Miraflores Locks 9,814 cubic yards, average division cost \$11.3013 per cubic yard.

Work on the electric transmission line and accessories was only started in May, and was not sufficiently advanced at the close of the year to furnish unit costs.

The classification for the erection of the aids to navigation was revised during the year, and cost of each tower and project is shown in detail in table No. 5. The large amount carried under "Material on hand" covers the cost of gas buoys which have not yet been placed in position.

For the Cristobal terminal facilities the only projects commenced were the fuel-oil storage tanks at Mount Hope, on which \$13,063.59 had been expended to the close of the fiscal year; and preliminary work for dredging site of coal-handling plant at Cristobal, such as clearing, drilling, and blasting, on which \$1,424.55 was expended during the month of June.

Work on the terminal facilities at Balboa was commenced during the fiscal year 1912, and the following is a summary of the quantities accomplished, division cost and unit cost, up to the close of the fiscal year 1913:

In preliminary work, general surveys, etc., there had been expended \$28,428.69; in preparing the site, removal of buildings, tracks, etc., there had been expended \$167,627.26. There had been excavated 412,707 cubic yards of material, at a cost of \$231,957.57, or \$0.5620 per cubic yard. In filling and grading 505,419 cubic yards of material had been used, at a cost of \$201,764.07, or \$0.3992 per cubic yard, and in arrangements of yards and tracks \$15,051.61 had been expended.

During the fiscal year 1912, 370,607 cubic yards were dredged from the inner harbor, at an average division cost of \$0.1580 per cubic yard; in 1913, 1,401,207 cubic yards were dredged, at a division cost of \$0.1538 per cubic yard, a total to date of 1,771,814 cubic yards, at an average division cost of \$0.1547 per cubic yard. Of the above quantity 1,080,700 cubic yards were handled by a pipe-line suction dredge and used in reclaiming land between Diablo Hill, Ancon, and Balboa, necessitating the use of a relay pump and extra pipe line, at an additional expense of \$46,957.65, or \$0.0435 per cubic yard, which is included in total division cost above quoted.

On main dry dock there had been expended \$19,660.27 for preliminary work, such as designing, surveys, etc., and 145,478 cubic yards of material had been excavated, at a cost of \$123,087.95, or \$0.8461 per cubic yard, and \$756.25 had been expended on ironwork.

On the coaling plant \$2,272.75 had been expended for designing, surveys, etc., and 58,221 cubic yards of material had been excavated, at a cost of \$49,260.40, or \$0.8461 per cubic yard.

On the sea wall \$2.73 had been expended in surveys.

On the permanent shops \$40,402.13 had been expended in preliminary work, such as clearing, designing, surveying, etc.; \$201,757.21 on foundations; \$4,781.69 on floors; \$15,706.86 on steel erection; \$1,959.80 on superstructure and roofs; \$5,467.55 on installation of machinery; and \$5,176.81 on miscellaneous items. In preparing the foundations 29,684 cubic yards of excavation had been accomplished, at a division cost of \$1.5607 per cubic yard; 7,787 cubic yards of concrete had been placed, at a division cost of \$9.2091 per cubic yard; 135,442 linear feet of wood piles and 3,060 linear feet of concrete piles had been driven, at a division cost of \$0.4820 and \$3.2358 per linear foot, respectively; 315 feet of 4-foot steel cylinders had been driven, at a division cost of \$14.9252 per linear foot; and 4,338 cubic yards of back fill had been placed, at an average division cost of \$0.7619. The expenditures by buildings had been:

Preliminary work, general.....	\$30, 579. 91
Steel erection, general.....	14, 450. 25
Machine and erecting shop.....	34, 627. 76
Forge shop.....	8, 492. 48
Steel storage shed.....	8, 974. 95
Boiler and ship fitters' shop.....	18, 665. 57
General storehouse.....	43, 693. 34
Paint shop.....	9, 869. 00
Car shop.....	4, 000. 37
Planing mill.....	9, 738. 08
Galvanizing building.....	1, 810. 24
Lumber and equipment shed.....	15, 174. 99
Pattern-storage room.....	6, 671. 04
Foundry.....	22, 555. 26
Coke shed.....	1, 580. 26
Boiler house.....	75. 93
Roundhouse.....	10, 163. 70
Gas house.....	185. 70
Toilets.....	128. 36
Paint house.....	11. 53
Main office.....	171. 01
Tunnel.....	33, 632. 32
Total.....	275, 252. 05

The steel for these buildings is being erected by the contractors, and when the work is completed the cost will be apportioned to the various buildings on the basis of tonnage.

In constructing the docks there had been expended for preliminary work, such as surveys, borings, etc., \$29,113.77; there had been excavated for the concrete piers 28,834 cubic yards of material, at a cost of \$79,807.36, or \$2.7678 per cubic yard; 9,446 cubic yards of concrete caissons had been manufactured and placed on site, at a cost of \$121,124.81, or \$12.8228 per cubic yard; and 3,914 cubic yards of concrete had been placed in these caissons, at a cost of \$28,752.54, or \$7.3461 per cubic yard. At the close of the fiscal year 12.435 linear feet of caissons were in place, at a cost, including excavation, of \$18.4708 per linear foot. In preliminary work in connection with the concrete floor system \$30,379.91 had been expended for forms, reenforcements, etc., though no concrete had yet been placed, and \$1,977.26 had been expended for miscellaneous items. On fuel-oil-storage tanks \$2,676.18 had been expended.

In preparing the permanent town site at Balboa \$45,807.55 had been expended, and on that at La Boca for silver employees \$6,651.22. At the close of the fiscal year 1913 the administration building was the only permanent building in course of construction, except the shop buildings, which are carried under "Terminal facilities." There had been expended on this building \$32,976.61. In preparation of foundations and in grading site 38,073 cubic yards of material had been excavated, at an average division cost of \$0.5654, and 770 cubic yards of concrete had been laid in the foundations, at an average division cost of \$12.8646 per cubic yard. There had also been charged to the account "Permanent buildings" \$20,445.51 for architects' fees and for designing, and \$2,496.64 for value of wooden buildings transferred from Gorgona to La Boca for use of silver employees.

## EXHIBIT D. PERFORMANCE SHEETS.

TABLE NO. 4. ROCK CRUSHER.

A comparative summary of the performance of the rock-crushing plant at Ancon for the fiscal years 1913 and 1912 is given in the following table:

	1913	1912
Hours in service.....	2,988.00	3,315.00
Hours at work.....	2,278.11	2,383.78
Cubic yards stone produced.....	676,374.00	837,908.00
Average number cubic yards per hour in service.....	226.36	252.76
Average number cubic yards per hour at work.....	296.90	351.50
Per cent of working time to hours in service.....	76.24	71.91

The Porto Bello quarry was not operated during the year.

TABLE NO. 3. UNLOADING PLANT.

The unloading cableways at Gatun were only operated to unload sand secured from the hydraulic fill borrow pits and to reclaim sand at the stock pile, and no reports of performance were prepared. A comparative statement of the work of the unloading cranes at Balboa for the fiscal years 1913 and 1912 follows:

	1913	1912
Average number operated.....	1.96	2.00
Total unit hours in service.....	4,698.00	4,872.00
Total unit hours at work.....	2,938.00	3,499.50
Cubic yards material handled.....	445,658.00	564,837.00
Average number of cubic yards material handled per hour in service.....	94.86	115.94
Average number of cubic yards material handled per hour at work.....	151.69	161.41
Per cent of working time to hours in service.....	62.54	71.83

## MIXING PLANTS.

A comparison of the work done by the mixing plants in the Atlantic and Pacific divisions during the fiscal years 1913 and 1912 follows:

*Atlantic division, Table No. 1.*

	Construction plant.	
	1913	1912
Average number mixers in use.....	2.50	4.30
Total hours in service.....	6,522.94	13,453.06
Total hours at work.....	2,765.91	5,794.30
Cubic yards concrete mixed.....	165,839.00	343,364.00
Average number of cubic yards of concrete mixed per hour in service.....	25.42	25.52
Average number of cubic yards of concrete mixed per hour at work.....	59.95	59.26
Per cent of working time to hours in service.....	42.40	43.07



*Pacific division, Tables Nos. 5, 6, and 7.*

	Pedro Miguel Locks, auxiliary plant.		Mirafleres Locks.			
			Berm cranes.		Auxiliary mixers.	
	1913 <sup>1</sup>	1912	1913	1912	1913 <sup>2</sup>	1912
Average number of mixers in use.....	1.00	2.14	6.07	6.55	2.06	2.09
Total hours in service.....	390.00	5,844.50	17,280.26	19,287.99	2,180.50	6,291.00
Total hours at work.....	177.50	3,391.67	8,163.19	10,763.85	1,423.56	3,820.85
Cubic yards concrete mixed.....	5,835	122,497	308,914	409,651	97,603	253,450
Average number cubic yards concrete mixed per hour in service.....	14.94	20.96	17.88	21.24	44.76	40.29
Average number cubic yards concrete mixed per hour at work.....	32.87	36.12	37.84	38.06	68.56	66.33
Per cent working time to hours in service.....	45.45	58.03	47.24	55.80	65.29	60.74

<sup>1</sup> To Aug. 17 only.<sup>2</sup> To Oct. 26 only.

The above tables do not include the performance of small mixers, which worked intermittently during the year.

## TABLES NOS. 2, 7, AND 8. PLACING PLANTS.

A comparative statement of the work done by the placing plants in the Atlantic and Pacific divisions follows:

	Atlantic division, cableway strands.		Pacific division, Mirafleres.			
			Chamber cranes.		Berm cranes.	
	1913	1912	1913	1912	1913	1912
Average number operated.....	7.83	8.00	3.83	2.48	3.24	3.58
Total number hours in service.....	21,381.01	25,404.60	11,937.50	7,486.96	9,275.50	10,502.00
Total number hours handling concrete.....	5,530.15	9,840.53	6,025.02	4,143.23	4,362.85	5,827.31
Total number hours handling steel, forms, etc.....	4,738.69	4,514.33	876.24	674.17	252.83	683.86
Cubic yards concrete and other material handled.....	158,262	309,534	310,494	241,862	308,914	409,651
Average number of cubic yards of concrete and material handled per hour in that work.....	28.62	31.46	51.53	58.38	70.81	70.30
Per cent of working time to hours in service.....	48.03	56.51	57.81	64.34	49.76	62.00

## EXHIBIT E. ADMINISTRATIVE AND GENERAL EXPENSES.

Administrative and general expenses were:

During the fiscal year 1913.....	\$2,340,674.87
During the fiscal year 1912.....	2,227,157.68

An increase of..... 113,517.19

Or 5.10 per cent.

The principal items of increase were: General expenses on the Isthmus, \$19,282.76, due principally to transfer of cost-keeping accounts to Chief Engineer's office and to additional expense for permanent files division; canal record, \$3,254.35, due to increase in size of certain issues; disbursing officers on Isthmus and in the United

States, \$2,609.86 and \$2,799.87, respectively; examiner of accounts on Isthmus, \$35,411.59, principally due to expenses of time keeping from January to June, formerly borne by the divisions; operation of stores, \$41,326.31, in switching and crane service from other departments and in freight charges; recruiting and repatriating, \$11,862.04, there being more employees recruited in the United States, and greater expenditures for repatriating employees who had served two years or more; quarters, \$32,966.94, due to shifting of force from one station to another, freight charges, and to larger number of persons in quarters; operations docks and wharves, \$17,612.40, due to handling over dock a large quantity of heavy material for locks, operating machinery, etc. These increases are partially offset by decreases in the following items: General administrative expenses, \$9,723.27, expenses of drafting and designing forces formerly charged to this account being now charged directly to project benefited; Isthmian Canal Commission band, \$3,713.15, the band being abolished February 28; miscellaneous general expenses in the United States, \$5,940.39, there being heavy charges last year for services of Special Commissioner Emory R. Johnson; telegraph and telephones, \$38,335.52, due to decrease in monthly payments to the Panama Railroad Co. for this service; purchasing expenses in the United States, \$2,447.74.

#### EXHIBIT F. SALARY DISBURSEMENTS BY DEPARTMENTS AND DIVISIONS.

The Congress appropriates separately for "Pay of officers and employees" and for "Skilled and unskilled labor." Disbursements from these appropriations by the department of construction and engineering for the year 1913 totaled \$18,393,000.15, against \$17,673,385.61 in 1912. During 1913, 19.75 per cent of the amount disbursed was from the appropriation "Officers and employees" and 80.25 per cent from the appropriation for "Skilled and unskilled labor," the proportion for 1912 having been 20.55 per cent and 79.45 per cent, respectively.

From the appropriation "Pay of officers and employees" are paid the salaries of the clerical and supervisory forces, so that the disbursements therefrom are in the nature of a surcharge on the productive salary expenditures, represented by the disbursements from the appropriation "Skilled and unskilled labor." In 1913 the disbursements from appropriation "Officers and employees" equaled a surcharge of 24.61 per cent on the disbursements from appropriation "Skilled and unskilled labor"; and in 1912 of 25.86 per cent, indicating a saving in clerical and supervisory forces of \$184,779.53.

Appended hereto are the exhibits referred to in this report.

Respectfully submitted.

AD. FAURE,  
*Cost Keeping Accountant.*

Col. GEORGE W. GOETHALS, U. S. Army,  
*Chairman and Chief Engineer, Culebra, Canal Zone.*

## EXHIBITS SUBMITTED WITH ANNUAL REPORT OF COST-KEEPING ACCOUNTANT.

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EXHIBIT A.—STATEMENT OF CONSTRUCTION EXPENDITURES TO JUNE 30, 1913.

TABLE 1.—Statement of construction expenditures to June 30, 1913.

ATLANTIC DIVISION.

	Quantities.	Total division expenses, including arbitraries for plant.		Administrative and general expenses.		Total cost.	
		Amount.	Unit cost.	Amount.	Unit cost.	Amount.	Unit cost.
Dry excavation—Prism:							
May 4, 1904, to June 30, 1909.....	<i>Cu. yds.</i> 1, 152, 105	\$673, 330. 97	\$0. 5844	\$102, 017. 26	\$0. 0886	\$775, 348. 23	\$0. 6730
Fiscal year 1910.....	324, 716	201, 916. 36	. 6218	24, 985. 55	. 0770	226, 901. 91	. 6988
Fiscal year 1911.....	280, 305	168, 440. 60	. 6010	13, 946. 79	. 0497	182, 387. 39	. 6507
Fiscal year 1912.....	424, 872	252, 886. 45	. 5952	17, 265. 97	. 0406	270, 152. 42	. 6358
Fiscal year 1913.....		13, 910. 16				13, 910. 16	
Total to June 30, 1913	2, 181, 998	1, 310, 484. 54	. 6006	158, 215. 57	. 0725	1, 468, 700. 11	. 6731
Hydraulic excavation—Prism:							
Fiscal year 1911.....	28, 605	7, 721. 28	. 2699	1, 143. 49	. 0400	8, 864. 77	. 3099
Fiscal year 1912.....	1, 000	2, 597. 59	2. 5976	208. 96	. 2090	2, 806. 55	2. 8066
Total to June 30, 1913	29, 605	10, 318. 87	. 3485	1, 352. 45	. 0457	11, 671. 32	. 3942

## EXHIBIT A.—STATEMENT OF CONSTRUCTION EXPENDITURES TO JUNE 30, 1913—Contd.

TABLE 1.—Statement of construction expenditures to June 30, 1913—Continued.

## ATLANTIC DIVISION—Continued.

	Quantities.	Total division expenses, including arbitraries for plant.		Administrative and general expenses.		Total cost.	
		Amount.	Unit cost.	Amount.	Unit cost.	Amount.	Unit cost.
Dredging excavation, prism:							
May 4, 1904, to June 30, 1909.....	<i>Cu. yds.</i> 13, 188, 123	\$2, 654, 951.70	\$0. 2013	\$273, 425.93	\$0. 0207	\$2, 928, 377.63	\$0. 2220
Fiscal year 1910.....	4, 955, 660	1, 109, 667.60	. 2360	131, 370.17	. 0265	1, 301, 037.77	. 2625
Fiscal year 1911.....	5, 828, 345	1, 291, 257.03	. 2215	126, 902.35	. 0218	1, 418, 159.38	. 2433
Fiscal year 1912.....	4, 870, 827	1, 208, 226.15	. 2481	100, 928.48	. 0207	1, 309, 154.63	. 2688
Fiscal year 1913.....	6, 483, 408	1, 356, 771.78	. 2093	108, 556.23	. 0167	1, 465, 328.01	. 2260
Total to June 30, 1913	35, 326, 363	7, 680, 874.26	. 2174	741, 183.16	. 0210	8, 422, 057.42	. 2384
Plant, amount to be absorbed after June 30, 1913.....		93, 373.02				93, 373.02	
Total.....		7, 774, 247.28		741, 183.16		8, 515, 430.44	
GATUN SPILLWAY.							
Dry excavation:							
May 4, 1904, to June 30, 1909.....	1, 296, 332	778, 514.20	. 6006	127, 355.38	. 0982	905, 869.58	. 6988
Fiscal year 1910.....	122, 487	117, 945.47	. 9629	15, 460.31	. 1262	133, 405.78	1. 0891
Fiscal year 1911.....	125, 383	51, 014.89	. 4069	5, 890.34	. 0470	56, 905.23	. 4539
Total to June 30, 1913	1, 544, 202	947, 474.56	. 6136	148, 706.03	. 0963	1, 096, 180.59	. 7099
Preparing foundations:							
Fiscal year 1910.....	4, 723	18, 632.78	3. 9451	2, 732.07	. 5785	21, 364.85	4. 5236
Fiscal year 1911.....	32, 245	48, 521.10	1. 5048	5, 893.94	. 1828	54, 415.04	1. 6876
Fiscal year 1912.....	7, 123	18, 804.83	2. 6400	1, 882.79	. 2643	20, 687.62	2. 9043
Fiscal year 1913.....	175	418.48	2. 3913	132.54	. 7574	551.02	3. 1487
Total to June 30, 1913	44, 266	86, 377.19	1. 9513	10, 641.34	. 2404	97, 018.53	2. 1917
Masonry:							
Concrete, plain—							
May 4, 1904, to June 30, 1909....	30, 464	223, 203.73	7. 3268	20, 565.26	. 6751	243, 768.99	8. 0019
Fiscal year 1910.....	53, 632	461, 338.27	8. 6019	27, 380.14	. 5105	488, 718.41	9. 1124
Fiscal year 1911.....	59, 651	399, 925.98	6. 7044	16, 875.75	. 2829	416, 801.73	6. 9873
Fiscal year 1912.....	58, 048	407, 108.10	7. 0133	23, 825.85	. 4105	430, 933.95	7. 4238
Fiscal year 1913.....	20, 653	161, 556.53	7. 8224	17, 838.63	. 8637	179, 395.16	8. 6861
Total to June 30, 1913	222, 448	1, 653, 132.61	7. 4315	106, 485.63	. 4787	1, 759, 618.24	7. 9102
Concrete, reenforced—							
Fiscal year 1912.....	618	9, 370.80	15. 1631	704.30	1. 1396	10, 075.10	16. 3027
Fiscal year 1913.....	1, 066	14, 860.14	13. 9401	2, 033.54	1. 9076	16, 893.68	15. 8477
Total to June 30, 1913.....	1, 684	24, 230.94	14. 3889	2, 737.84	1. 6258	26, 968.78	16. 0147
Total masonry.....	224, 132	1, 677, 363.55	7. 4838	109, 223.47	. 4873	1, 786, 587.02	7. 9711
Ironwork:							
Fiscal year 1910.....		346.26		41.60		387.86	
Fiscal year 1911.....		16, 869.54		2, 573.79		19, 443.33	
Fiscal year 1912.....		80, 153.39		14, 133.29		94, 286.68	
Fiscal year 1913.....		33, 921.54		6, 996.03		40, 917.57	
Total to June 30, 1913		131, 290.73		23, 744.71		155, 035.44	
Gates:							
Fiscal year 1912.....		29, 981.71				29, 981.71	
Fiscal year 1913.....		43, 750.51		2, 738.61		46, 489.12	
Total to June 30, 1913		73, 732.22		2, 738.61		76, 470.83	

## EXHIBIT A.—STATEMENT OF CONSTRUCTION EXPENDITURES TO JUNE 30, 1913—Contd.

TABLE 1.—Statement of construction expenditures to June 30, 1913—Continued.

## ATLANTIC DIVISION—Continued.

	Quantities.	Total division expenses, including arbitraries for plant.		Administrative and general expenses.		Total cost.	
		Amount.	Unit cost.	Amount.	Unit cost.	Amount.	Unit cost.
GATUN SPILLWAY—contd.							
Operating machinery: Fiscal year 1913 (total).....	<i>Cu. yds.</i>	\$91,122.95		\$1,641.34		\$92,764.29	
Back filling:							
Fiscal year 1910.....	1,781	1,005.69	\$0.5647	93.55	\$0.0525	1,099.24	\$9.6172
Fiscal year 1911.....	12,873	6,220.54	.4832	773.45	.0601	6,993.99	.5433
Fiscal year 1912.....	10,062	3,921.88	.3898	441.07	.0438	4,362.95	.4336
Total to June 30, 1913	24,716	11,148.11	.4511	1,308.07	.0529	12,456.18	.5040
Total Gatun Spillway.....		3,018,509.31		298,003.57		3,316,512.88	
GATUN DAM.							
Dredging excavation: May 4, 1904, to June 30, 1909 (total).....	38,425	18,322.71	.4769	1,718.48	.0447	20,041.19	.5216
Dry filling:							
May 4, 1904, to June 30, 1909.....	2,244,622	927,319.57	.4131	181,339.46	.0808	1,108,659.03	.4939
Fiscal year 1910.....	2,555,197	757,828.15	.2966	87,078.24	.0340	844,906.39	.3306
Fiscal year 1911.....	2,675,945	1,018,351.43	.3806	76,382.58	.0285	1,094,734.01	.4091
Fiscal year 1912.....	2,626,447	1,356,471.78	.5165	94,331.18	.0359	1,450,802.96	.5524
Fiscal year 1913.....	1,812,733	643,726.42	.3551	56,392.04	.0311	700,118.46	.3862
Total to June 30, 1913	11,914,944	4,703,697.35	.3948	495,523.50	.0416	5,199,220.85	.4364
Hydraulic filling:							
May 4, 1904, to June 30, 1909.....	720,047	162,553.19	.2258	34,540.85	.0479	197,094.04	.2737
Fiscal year 1910.....	2,933,175	786,641.96	.2682	59,910.57	.0204	846,552.53	.2886
Fiscal year 1911.....	4,256,393	974,230.44	.2289	77,572.23	.0182	1,051,802.67	.2471
Fiscal year 1912.....	2,604,632	1,001,405.34	.3844	52,407.82	.0201	1,053,813.16	.4045
Fiscal year 1913.....	214,718	44,885.52	.2090	9,521.55	.0444	54,407.07	.2534
Total to June 30, 1913	10,728,965	2,969,716.45	.2768	233,953.02	.0218	3,203,669.47	.2986
Paving:							
Excavation, fiscal year 1913 (total).....	15,078	31,704.98	2.1027	3,850.80	.2554	35,555.78	2.3581
Placing riprap, fiscal year 1913 (total).....	68,730	45,181.42	.4429	2,204.24	.0215	47,385.66	.4644
Placing broken stone, fiscal year 1913 (total).....	15,740	38,620.09	2.4536	2,032.83	.1292	40,652.92	2.5828
Total paving.....		115,506.49		8,087.87		123,594.36	
Surfacing (square yards), fiscal year 1913 (total).....	225,400	4,756.90	.0211	570.40	.0025	5,327.30	.0236
Total Gatun Dam.....		7,811,999.90		739,853.27		8,551,853.17	
Total Gatun Dam and Spillway.....		10,830,509.21		1,037,856.84		11,868,366.05	
Plant, overcharge to be adjusted on completion of work.....		295,447.57				295,447.57	
Total.....		10,535,061.64		1,037,856.84		11,572,918.48	

## EXHIBIT A.—STATEMENT OF CONSTRUCTION EXPENDITURES TO JUNE 30, 1913—Contd.

TABLE 1.—Statement of construction expenditures to June 30, 1913—Continued.

## ATLANTIC DIVISION—Continued.

	Quantities.	Total division expenses, including arbitraries for plant.		Administrative and general expenses.		Total cost.	
		Amount.	Unit cost.	Amount.	Unit cost.	Amount.	Unit cost.
GATUN LOCKS.							
Dry excavation:							
May 4, 1904, to June 30, 1909.....	<i>Cu. yds.</i> 3,240,218	\$1,729,279.35	\$0.5337	\$217,726.78	\$0.0672	\$1,947,006.13	\$0.6009
Fiscal year 1910.....	839,302	687,602.40	.8193	73,991.47	.0881	761,593.87	.9074
Fiscal year 1911.....	475,875	338,332.43	.7110	37,019.15	.0778	375,351.58	.7888
Fiscal year 1912.....		<b>3,337.87</b>				<b>3,337.87</b>	
Fiscal year 1913.....	104,660	63,229.86	.6041	4,987.33	.0477	68,217.19	.6518
Total to June 30, 1913.....	4,660,055	2,815,106.17	.6041	333,724.73	.0716	3,148,830.90	.6757
Dredging excavation:							
May 4, 1904, to June 30, 1909.....	488,533	79,978.65	.1637	9,427.51	.0193	89,406.16	.1830
Fiscal year 1911.....		2,999.32		305.94		3,305.26	
Fiscal year 1912.....	883,918	276,568.07	.3129	11,576.12	.0131	288,144.19	.3260
Fiscal year 1913.....	384,526	166,461.53	.4329	14,606.71	.0380	181,068.24	.4709
Total to June 30, 1913.....	1,756,977	526,007.57	.2994	35,916.28	.0204	561,923.85	.3198
Preparing foundations:							
Excavation—							
Fiscal year 1910...	33,843	85,109.77	2.5148	13,392.73	0.3957	98,502.50	2.9105
Fiscal year 1911...	152,582	237,098.48	1.5540	27,640.92	.1811	264,739.40	1.7351
Fiscal year 1912...	8,888	26,307.20	2.9598	2,207.51	.2484	28,514.71	3.2082
Fiscal year 1913...	33,063	56,246.52	1.7012	5,995.89	.1813	62,242.41	1.8825
Total to June 30, 1913.....	228,376	404,761.97	1.7723	49,237.05	.2156	453,999.02	1.9879
Dredging, fiscal year 1913 (total).....							
	19,814	36,581.03	1.8462	3,139.47	.1585	39,720.50	2.0047
Filling, approach walls—							
Fiscal year 1910...	17,883	10,607.43	.5932			10,607.43	.5932
Fiscal year 1911...	22,234	4,239.79	.1907	379.51	.0171	4,619.30	.2078
Fiscal year 1913...	1,544	1,161.41	.7522	126.33	.0818	1,287.74	.8340
Total to June 30, 1913.....	41,661	16,008.63	.3843	505.84	.0121	16,514.47	.3964
Concrete piling, approach walls (linear feet)—							
Fiscal year 1911...	8,196	18,129.46	2.2120	635.29	.0775	18,764.75	2.2895
Fiscal year 1912...	75,474	113,389.34	1.5032	2,418.27	.0320	115,807.61	1.5352
Fiscal year 1913.....		3,833.00				3,833.00	
Total to June 30, 1913.....	83,670	135,351.80	1.6177	3,053.56	.0365	138,405.36	1.6542
Wooden piling, approach walls (linear feet)—							
Fiscal year 1912...	51,450	33,525.15	.6516	4,345.26	.0845	37,870.41	.7361
Fiscal year 1913...	200,549	110,389.05	.5504	16,353.33	.0816	126,742.38	.6320
Total to June 30, 1913.....	251,999	143,914.20	.5711	20,698.59	.0821	164,612.79	.6532
Masonry:							
Concrete, plain—							
May 4, 1904, to June 30, 1909.....		15,093.59		2,054.67		17,148.26	
Fiscal year 1910...	513,803	3,779,163.81	7.3553	204,596.95	.3983	3,983,760.76	7.7535
Fiscal year 1911...	902,926	5,952,003.08	6.5919	199,380.61	.2208	6,151,383.69	6.8127
Fiscal year 1912...	390,611	2,785,709.13	7.1317	103,230.79	.2643	2,888,939.92	7.3960
Fiscal year 1913.....	137,749	900,643.05	6.5383	55,186.28	.4006	955,829.33	6.9389
Total to June 30, 1913.....	1,945,089	13,432,612.66	6.9059	564,449.30	.2902	13,997,061.96	7.1961

## EXHIBIT A.—STATEMENT OF CONSTRUCTION EXPENDITURES TO JUNE 30, 1913—Contd.

TABLE 1.—Statement of construction expenditures to June 30, 1913—Continued.

## ATLANTIC DIVISION—Continued.

	Quantities.	Total division expenses, including arbitraries for plant.		Administrative and general expenses.		Total cost.	
		Amount.	Unit cost.	Amount.	Unit cost.	Amount.	Unit cost.
GATUN LOCKS—contd.							
Masonry—Continued.							
Concrete, reinforced—	<i>Cu. yds.</i>						
Fiscal year 1911.....	8,211	\$102,216.13	\$12.4487	\$9,261.28	\$1.1279	\$111,477.41	\$13.5766
Fiscal year 1912.....	59,883	707,983.96	11.8228	50,105.37	.8367	758,089.33	12.6595
Fiscal year 1913.....	27,532	291,183.85	10.5762	32,140.82	1.1674	323,324.67	11.7436
Total to June 30, 1913.....	95,626	1,101,383.94	11.5176	91,507.47	.9569	1,192,891.41	12.4745
Total masonry..	2,040,715	14,533,996.60	7.1220	655,956.77	.3214	15,189,953.37	7.4434
Ironwork:							
Fiscal year 1910.....		226,554.37		26,112.31		252,666.68	
Fiscal year 1911.....		593,807.35		87,802.13		681,609.48	
Fiscal year 1912.....		337,786.43		42,566.42		380,352.85	
Fiscal year 1913.....		76,202.24		38,640.85		37,561.39	
Total to June 30, 1913.....		1,234,350.39		117,840.01		1,352,190.40	
Gates and fender chains:							
Fiscal year 1911.....		40,586.48		5,999.82		46,586.30	
Fiscal year 1912.....		868,144.22		107,052.85		975,197.07	
Fiscal year 1913.....		1,320,190.55		47,180.95		1,273,009.60	
Total to June 30, 1913.....		2,228,921.25		65,871.72		2,294,792.97	
Emergency dams, fiscal year 1913 (total).....							
		816,184.77		6,493.97		822,678.74	
Operating machinery:							
Fiscal year 1912.....		531,793.93		22,043.38		553,837.31	
Fiscal year 1913.....		1,836,370.15		72,778.48		1,909,148.63	
Total to June 30, 1913.....		2,368,164.08		94,821.86		2,462,985.94	
Concrete in machinery installation, fiscal year 1913 (total).....							
	16,706	224,068.56	13.4124	21,632.01	1.2949	245,700.57	14.7073
Control house:							
Masonry, fiscal year 1913 (total).....	568	15,459.54	27.2175	1,254.40	2.2085	16,713.94	29.4260
Ironwork and miscellaneous, fiscal year 1913 (total).....		3,511.28		62.29		3,573.57	
Machinery installation, fiscal year 1913 (total).....		20.84				20.84	
Total control house.....		18,991.66		1,316.69		20,308.35	
Buffer timbers, fiscal year 1913 (total).....							
		8,946.40		614.25		9,560.65	
Crib fenders, fiscal year 1913 (total).....							
		10,479.86		817.22		11,297.08	
Back fill:							
Fiscal year 1910.....	4,190	4,811.52	1.1483	388.29	.0927	5,199.81	1.2410
Fiscal year 1911.....	535,669	284,221.51	.5307	29,446.89	.0549	313,668.40	.5856
Fiscal year 1912.....	922,215	425,613.92	.4615	36,766.53	.0399	462,380.45	.5014
Fiscal year 1913.....	565,756	215,314.33	.3805	25,498.27	.0451	240,812.60	.4256
Total to June 30, 1913.....	2,027,830	929,961.28	.4586	92,099.98	.0454	1,022,061.26	.5040



## EXHIBIT A.—STATEMENT OF CONSTRUCTION EXPENDITURES TO JUNE 30, 1913—Contd.

TABLE 1.—Statement of construction expenditures to June 30, 1913—Continued.

## ATLANTIC DIVISION—Continued.

	Quantities.	Total division expenses, including arbitraries for plant.		Administrative and general expenses.		Total cost.	
		Amount.	Unit cost.	Amount.	Unit cost.	Amount.	Unit cost.
GATUN LOCKS—contd.							
Filling center wall:	<i>Cu. yds.</i>						
Fiscal year 1911.....	2,717	\$2,889.16	\$1.0634	\$212.09	\$0.0780	\$3,101.25	\$1.1414
Fiscal year 1912.....	94,574	71,946.90	.7607	2,809.91	.0297	74,756.81	.7904
Fiscal year 1913.....	15,872	13,205.65	.8320	689.38	.0434	13,895.03	.8754
Total to June 30, 1913	113,163	88,041.71	.7780	3,711.38	.0328	91,753.09	.8108
Filling around south approach wall, fiscal year 1912 (total):							
Dry.....	7,072	3,600.90	.5092	176.71	.0250	3,777.61	.5342
Hydraulic.....	594,495	91,847.98	.1545	2,229.51	.0037	94,077.49	.1582
Total.....		95,448.88		2,406.22		97,855.10	
Total Gatun Locks Plant, amount to be absorbed after June 30, 1913		26,635,286.81		1,509,857.60		28,145,144.41	
		198,251.22				198,251.22	
Total.....		26,833,538.03		1,509,857.60		28,343,395.63	
GATUN PERMANENT POWER PLANT.							
Dry excavation:							
Fiscal year 1912.....	72,119	27,163.41	.3767	1,596.61	.0221	28,760.02	.3988
Fiscal year 1913.....	14,948	6,012.12	.4022	538.31	.0360	6,550.43	.4382
Total to June 30, 1913	87,067	33,175.53	.3811	2,134.92	.0245	35,310.45	.4056
Preparing foundations, fiscal year 1913 (total).....	11,684	20,999.20	1.7973	2,127.99	.1821	23,127.19	1.9794
Masonry substructure, fiscal year 1913 (total).....	5,068	43,452.32	8.5739	2,394.21	.4724	45,846.53	9.0463
Masonry superstructure, fiscal year 1913 (total).....		1,983.29		192.60		2,175.89	
Miscellaneous construction, fiscal year 1913 (total).....		40,953.30		7,284.67		48,237.97	
Operating machinery:							
Fiscal year 1912.....		8,855.00				8,855.00	
Fiscal year 1913.....		192,666.91		7,882.91		200,549.82	
Total to June 30, 1913		201,521.91		7,882.91		209,404.82	
Total Gatun power plant.....		342,085.55		22,017.30		364,102.85	
Plant, amount to be absorbed after June 30, 1913		2,195.54				2,195.54	
Total.....		344,281.09		22,017.30		366,298.39	
GATUN-MINDI LEVEE.							
Dry filling:							
Fiscal year 1910.....	126,002	51,789.04	.4110	6,125.69	.0486	57,914.73	.4596
Fiscal year 1911.....	51,156	10,128.74	.1979	941.68	.0184	11,070.42	.2163
Total to June 30, 1913	177,158	61,917.78	.3495	7,067.37	.0399	68,985.15	.3894
Hydraulic filling, fiscal year 1911 (total).....	20,398	3,326.91	.1631	156.41	.0077	3,483.32	.1708
Total Gatun-Mindi Levee.....		65,244.69		7,223.78		72,468.47	

## EXHIBIT A.—STATEMENT OF CONSTRUCTION EXPENDITURES TO JUNE 30, 1913—Contd.

TABLE 1.—Statement of construction expenditures to June 30, 1913—Continued.

## ATLANTIC DIVISION—Continued.

	Quantities.	Total division expenses, including arbitraries for plant.		Administrative and general expenses.		Total cost.	
		Amount.	Unit cost.	Amount.	Unit cost.	Amount.	Unit cost.
COLON BREAKWATER.							
Dry filling:							
May 4, 1904, to June 30, 1909.....	<i>Cu. yds.</i>						
Fiscal year 1910.....		\$7,436.72				\$7,436.72	
Fiscal year 1911.....	359,890	43,773.31		\$4,910.83		48,684.14	
Fiscal year 1912.....	525,173	522,084.39	\$1.4506	87,177.40	\$0.2423	609,261.79	\$1.6929
Fiscal year 1913.....	183,762	916,821.49	1.7457	81,764.20	.1557	998,585.69	1.9014
		896,512.68	4.8787	75,697.83	.4119	972,210.51	5.2906
Total to June 30, 1913	1,068,825	2,386,628.59	2.2329	249,550.26	.2335	2,636,178.85	2.4664
Plant, amount to be absorbed after June 30, 1913.....		6,941.03				6,941.03	
Total Colon Breakwater.....		2,393,569.62		249,550.26		2,643,119.88	
TERMINAL FACILITIES, CRISTOBAL.							
Coaling plant, fiscal year 1913 (total).....		1,424.55				1,424.55	
Fuel-oil tanks, fiscal year 1913 (total).....		13,063.59				13,063.59	
Total terminal facilities, Cristobal.....		14,488.14				14,488.14	
CLEARING DRIFT IN GATUN LAKE.							
Fiscal year 1913 (total).....		5,666.11		17.16		5,683.27	
MANUFACTURING PLANTS.							
Amounts to be absorbed after June 30, 1913:							
Porto Bello quarry.....		185,627.32				185,627.32	
Sea transportation.....		305,866.29				305,866.29	
Total.....		491,493.61				491,493.61	
Total Atlantic division.....		49,778,393.62		3,727,274.12		53,505,667.74	

## EXHIBIT A.—STATEMENT OF CONSTRUCTION EXPENDITURES TO JUNE 30, 1913—Contd.

TABLE 2.—Statement of construction expenditures to June 30, 1913.

## CENTRAL DIVISION.

	Quantities.	Total division expenses, including arbitraries for plant.		Administrative and general expenses.		Total cost.	
		Amount.	Unit cost.	Amount.	Unit cost.	Amount.	Unit cost.
Dry excavation, prism:							
May 4, 1904, to June 30, 1909.....	<i>Cu. yds.</i> 40,983,366	\$37,540,874.34	\$0.9160	\$4,615,073.19	\$0.1126	\$42,155,947.53	\$1.0286
Fiscal year 1910.....	17,832,177	11,945,261.93	.6699	1,152,810.58	.0646	13,098,072.51	.7345
Fiscal year 1911.....	18,522,692	10,891,360.70	.5880	847,225.78	.0457	11,738,586.48	.6337
Fiscal year 1912.....	17,063,446	8,705,143.72	.5101	615,611.56	.0361	9,320,755.28	.5462
Fiscal year 1913.....	12,737,500	7,037,306.05	.5525	451,826.25	.0355	7,489,132.30	.5880
Total to June 30, 1913	107,139,181	76,119,946.74	.7105	7,682,547.36	.0717	83,802,494.10	.7822
Dredging excavation, prism:							
May 4, 1904, to June 30, 1909.....	—	8,067.72	—	1,730.68	—	9,798.40	—
Fiscal year 1913.....	—	183.47	—	—	—	183.47	—
Total to June 30, 1913	—	8,251.19	—	1,730.68	—	9,981.87	—
Hydraulic excavation, prism, fiscal year 1913 (total).....	57,274	10,511.46	.1835	—	—	10,511.46	.1835
Clearing canal line (acres):							
Fiscal year 1910.....	2,098	134,857.24	64.2789	—	—	134,857.24	64.2789
Fiscal year 1911.....	182	3,901.79	21.9329	467.38	2.5680	4,459.17	24.5009
Fiscal year 1912.....	—	2,029.51	—	80.83	—	2,110.34	—
Fiscal year 1913.....	250	7,378.30	29.5132	546.17	2.1847	7,924.47	31.6979
Total to June 30, 1913	2,530	148,256.84	58.5995	1,094.38	.4326	149,351.22	59.0321
Masonry:							
Fiscal year 1911.....	1,020	5,639.35	5.5288	585.09	.5736	6,224.44	6.1024
Fiscal year 1912.....	251	2,000.96	7.9719	128.26	.5110	2,129.22	8.4829
Total to June 30, 1913	1,271	7,640.31	6.0113	713.35	.5612	8,353.66	6.5725
Masonry facing (square yards), fiscal year 1912 (total).....	4,250	3,826.97	.9005	252.14	.0593	4,079.11	.9598
Plant, overcharge to be adjusted on completion of work.....	—	42,251.97	—	—	—	42,251.97	—
Total central division.....	—	76,256,181.54	—	7,686,337.91	—	83,942,519.45	—

## EXHIBIT A.—STATEMENT OF CONSTRUCTION EXPENDITURES TO JUNE 30, 1913—Contd.

TABLE 3.—Statement of construction expenditures to June 30, 1913.

## PACIFIC DIVISION.

	Quantities.	Total division expenses, including arbitraries for plant.		Administrative and general expenses.		Total cost.	
		Amount.	Unit cost.	Amount.	Unit cost.	Amount.	Unit cost.
<b>Dry excavation, prism:</b>							
May 4, 1904, to June 30, 1909.....	<i>Cu. yds.</i> 139,470	\$119,747.16	\$0.8586	\$21,514.28	\$0.1542	\$141,261.44	\$1.0128
Fiscal year 1910.....	99,703	63,266.48	.6345	6,622.63	.0664	69,889.11	.7009
Fiscal year 1911.....	198,770	138,349.00	.6960	12,662.38	.0637	151,011.38	.7597
Fiscal year 1912.....	864,475	650,658.11	.7527	37,383.22	.0432	688,041.33	.7959
Fiscal year 1913.....	3,210,851	2,126,300.10	.6622	148,889.65	.0464	2,275,189.75	.7086
Total to June 30, 1913	4,513,269	3,098,320.85	.6865	227,072.16	.0503	3,325,393.01	.7368
Plant, amount to be absorbed after June 30, 1913.....		62,619.43				62,619.43	
Total.....		3,160,940.28		227,072.16		3,388,012.44	
<b>Hydraulic excavation, prism:</b>							
Fiscal year 1911.....	197,677	120,714.14	.6106	9,088.12	.0460	129,802.26	.6566
Fiscal year 1912.....	900,596	501,065.72	.5564	25,560.51	.0284	526,626.23	.5848
Fiscal year 1913.....	451,631	456,749.25	1.0113	7,729.61	.0171	464,478.86	1.0284
Total to June 30, 1913	1,549,904	1,078,529.11	.6959	42,378.24	.0273	1,120,907.35	.7232
<b>Dredging excavation, prism:</b>							
May 4, 1904, to June 30, 1909.....	16,180,107	3,427,748.61	.2118	277,360.96	.0172	3,705,109.57	.2290
Fiscal year 1910.....	6,857,223	1,650,894.38	.2408	156,092.09	.0227	1,806,986.47	.2635
Fiscal year 1911.....	5,549,642	1,398,087.35	.2519	136,071.78	.0245	1,534,159.13	.2764
Fiscal year 1912.....	3,884,287	738,025.36	.1900	68,519.58	.0176	806,544.94	.2076
Fiscal year 1913.....	4,321,956	1,399,473.58	.3238	131,561.14	.0304	1,531,034.72	.3542
Total to June 30, 1913	36,793,215	8,614,229.28	.2341	769,605.55	.0209	9,383,834.83	.2550
Plant, amount to be absorbed after June 30, 1913.....		744,525.02				744,525.02	
Total.....		9,358,754.30		769,605.55		10,128,359.85	
<b>PEDRO MIGUEL DAMS.</b>							
<b>Dry excavation:</b>							
May 4, 1904, to June 30, 1909.....	4,074	5,241.81	1.2866			5,241.81	1.2866
Fiscal year 1910.....		925.47				925.47	
Fiscal year 1912.....	3,937	5,915.97	1.5026	445.35	.1132	6,361.32	1.6158
Fiscal year 1913.....	2,464	6,956.46	2.8233	640.11	.2598	7,596.57	3.0831
Total to June 30, 1913	10,475	19,039.71	1.8177	1,085.46	.1036	20,125.17	1.9213
<b>Dry filling:</b>							
May 4, 1904, to June 30, 1909.....	167,061	71,275.77	.4266	9,985.14	.0598	81,260.91	.4864
Fiscal year 1910.....	93,791	36,205.63	.3860	3,892.31	.0415	40,097.94	.4275
Fiscal year 1911.....		4,058.42		584.55		4,642.97	
Fiscal year 1912.....	321,589	162,084.64	.5040	4,107.42	.0128	166,192.06	.5168
Fiscal year 1913.....	114,117	37,793.84	.3312	3,087.98	.0270	40,881.82	.0582
Total to June 30, 1913	696,558	311,418.30	.4471	21,657.40	.0311	333,075.70	.4782
Masonry, fiscal year 1913 (total).....	1,567	7,872.65	5.0240	569.17	.3632	8,441.82	5.3872
Total Pedro Miguel Dams.....		338,330.66		23,312.03		361,642.69	

## EXHIBIT A.—STATEMENT OF CONSTRUCTION EXPENDITURES TO JUNE 30, 1913—Contd.

TABLE 3.—Statement of construction expenditures to June 30, 1913—Continued.

## PACIFIC DIVISION—Continued.

	Quantities.	Total division expenses, including arbitraries for plant.		Administrative and general expenses.		Total cost.	
		Amount.	Unit cost.	Amount.	Unit cost.	Amount.	Unit cost.
PEDRO MIGUEL LOCKS.							
Dry excavation:							
May 4, 1904, to June 30, 1909.....	<i>Cu. yds.</i> 720, 157	\$508, 834. 12	\$0. 7066	\$76, 019. 61	\$0. 1055	\$584, 853. 73	\$0. 8121
Fiscal year 1910.....	298, 500	354, 524. 81	1. 1876	48, 521. 87	. 1626	403, 046. 68	1. 3502
Fiscal year 1911.....	16, 423	9, 838. 84	. 5991	966. 86	. 0589	10, 805. 70	. 6580
Fiscal year 1912.....	95, 156	28, 714. 09	. 3018	2, 699. 30	. 0283	31, 413. 39	. 3301
Fiscal year 1913.....	3, 044	1, 241. 40	. 4078	61. 96	. 0204	1, 303. 36	. 4282
Total to June 30, 1913	1, 133, 280	903, 153. 26	. 7969	128, 269. 60	. 1132	1, 031, 422. 86	. 9101
Preparing foundations:							
Fiscal year 1910.....	44, 948	126, 722. 55	2. 8193	14, 916. 60	. 3319	141, 639. 15	3. 1512
Fiscal year 1911.....	76, 847	182, 477. 38	2. 3746	22, 073. 06	. 2872	204, 550. 44	2. 6618
Fiscal year 1912.....	38, 826	84, 311. 91	2. 1715	8, 314. 88	. 2142	92, 626. 79	2. 3857
Fiscal year 1913.....	15, 366	36, 702. 18	2. 3885	3, 888. 78	. 2531	40, 590. 96	2. 6416
Total to June 30, 1913	175, 987	430, 214. 02	2. 4446	49, 193. 32	. 2795	479, 407. 34	2. 7241
Masonry:							
Concrete, plain—							
Fiscal year 1910....	166, 869	1, 016, 107. 42	6. 0892	86, 704. 98	. 5196	1, 102, 812. 40	6. 6088
Fiscal year 1911....	497, 802	2, 341, 652. 75	4. 7042	138, 716. 42	. 2787	2, 480, 369. 17	4. 9827
Fiscal year 1912....	134, 193	767, 363. 31	5. 7183	41, 391. 93	. 3085	808, 755. 24	6. 0268
Fiscal year 1913....	39, 465	258, 228. 58	6. 5432	19, 109. 65	. 4842	277, 338. 23	7. 0274
Total to June 30, 1913.....	838, 329	4, 383, 352. 06	5. 2287	285, 922. 98	. 3411	4, 669, 275. 04	5. 5698
Concrete, reenforced—							
Fiscal year 1911....	385	6, 830. 91	17. 7426	773. 16	2. 0082	7, 604. 07	19. 7508
Fiscal year 1912....	48, 677	414, 705. 14	8. 5195	31, 361. 01	. 6443	446, 066. 15	9. 1638
Fiscal year 1913....	18, 697	177, 022. 08	9. 4679	20, 424. 19	1. 0924	197, 446. 27	10. 5603
Total to June 30, 1913.....	67, 759	598, 558. 13	8. 8336	52, 558. 36	. 7757	651, 116. 49	9. 6093
Total masonry..	906, 088	4, 981, 910. 19	5. 4983	338, 481. 34	. 3735	5, 320, 391. 53	5. 8718
Ironwork:							
May 4, 1904, to June 30, 1909.....		108, 843. 27		8, 190. 96		117, 034. 23	
Fiscal year 1910.....		143, 491. 51		3, 834. 93		147, 326. 44	
Fiscal year 1911.....		227, 470. 23		20, 665. 80		248, 136. 03	
Fiscal year 1912.....		100, 906. 24		19, 821. 24		120, 727. 48	
Fiscal year 1913.....		45, 120. 38		7, 123. 29		37, 997. 09	
Total to June 30, 1913.....		625, 831. 63		45, 389. 64		671, 221. 27	
Gates:							
Fiscal year 1911.....		6, 025. 59		878. 77		6, 904. 36	
Fiscal year 1912.....		776, 718. 78		20, 434. 97		797, 153. 75	
Fiscal year 1913.....		590, 814. 13		12, 632. 57		578, 181. 56	
Total to June 30, 1913.....		1, 373, 558. 50		8, 681. 17		1, 382, 239. 67	
Emergency dams, fiscal year 1913 (total).....		512, 480. 47		382. 02		512, 862. 49	
Operating machinery:							
Fiscal year 1912.....		168, 096. 64		6, 232. 82		174, 329. 46	
Fiscal year 1913.....		1, 070, 009. 31		39, 285. 60		1, 109, 294. 91	
Total to June 30, 1913.....		1, 238, 105. 95		45, 518. 42		1, 283, 624. 37	
Concrete in machine installation, fiscal year 1913 (total).....	10, 190	123, 767. 97	12. 1460	11, 389. 03	1. 1177	135, 157. 00	13. 2637

## EXHIBIT A.—STATEMENT OF CONSTRUCTION EXPENDITURES TO JUNE 30, 1913—Contd.

TABLE 3.—Statement of construction expenditures to June 30, 1913—Continued.

## PACIFIC DIVISION—Continued.

	Quantities.	Total division expenses, including arbitraries for plant.		Administrative and general expenses.		Total cost.	
		Amount.	Unit cost.	Amount.	Unit cost.	Amount.	Unit cost.
PEDRO MIGUEL LOCKS—continued.							
Control house:							
Masonry, fiscal year 1913 (total).....	Cu. yds. 205	\$8,197.62	\$39.9884	\$371.34	\$1.8114	\$8,568.96	\$41.799
Ironwork and miscellaneous, fiscal year 1913 (total).....		5,661.90				5,661.90	
Machinery installation, fiscal year 1913 (total).....		3.46				3.46	
Total control house.....		13,862.98		371.34		14,234.32	
Buffer timbers, fiscal year 1913 (total).....		9,365.08		448.53		9,813.61	
Back fill:							
Fiscal year 1910.....	9,616	2,737.77	.2847	278.81	.0290	3,016.58	.3137
Fiscal year 1911.....	273,709	106,753.75	.3900	8,619.21	.0315	115,372.96	.4215
Fiscal year 1912.....	349,275	123,456.12	.3535	7,944.35	.0227	131,400.47	.3762
Fiscal year 1913.....	173,938	80,738.23	.4642	7,187.30	.0413	87,925.53	.5055
Total to June 30, 1913	806,538	313,685.87	.3889	24,029.67	.0298	337,715.54	.4187
Filling center wall:							
Fiscal year 1912.....	21,937	21,131.29	.9633	1,677.84	.0765	22,809.13	1.0398
Fiscal year 1913.....	193,212	75,259.22	.3895	5,717.30	.0296	80,976.52	.4191
Total to June 30, 1913	215,149	96,390.51	.4480	7,395.14	.0344	103,785.65	.4824
Total Pedro Miguel locks.....		10,622,326.43		659,549.22		11,281,875.65	
Total Pedro Miguel locks and dams.....		10,960,657.09		682,861.25		11,643,518.34	
Plant:							
Amount to be absorbed after June 30, 1913.....		22,995.12				22,995.12	
Total.....		10,983,652.21		682,861.25		11,666,513.46	
MIRAFLORES EAST DAM AND SPILLWAY.							
Dry excavation:							
Fiscal year 1912.....		9,874.07		962.67		10,836.74	
Fiscal year 1913.....	134,671	216,835.99	1.6101	15,982.70	.1187	232,818.69	1.7288
Total to June 30, 1913	134,671	226,710.06	1.6835	16,945.37	.1258	243,655.43	1.8093
Masonry:							
Concrete, plain, fiscal year 1913 (total).....	63,707	366,672.90	5.7556	25,084.02	.3937	391,756.92	6.1493
Concrete, reinforced, fiscal year 1913 (total).....	435	8,536.26	19.6000	619.07	1.4214	9,155.33	21.0214
Total masonry.....	64,142	375,209.16	5.8497	25,703.09	.4007	400,912.25	6.2504
Ironwork:							
Fiscal year 1912.....		19,282.32		1,404.89		20,687.21	
Fiscal year 1913.....		2,248.09		1,387.49		3,635.58	
Total to June 30, 1913		21,530.41		2,792.38		24,322.79	

## EXHIBIT A.—STATEMENT OF CONSTRUCTION EXPENDITURES TO JUNE 30, 1913—Contd.

TABLE 3.—Statement of construction expenditures to June 30, 1913—Continued.

## PACIFIC DIVISION—Continued.

	Quantities.	Total division expenses, including arbitraries for plant.		Administrative and general expenses.		Total cost.	
		Amount.	Unit cost.	Amount.	Unit cost.	Amount.	Unit cost.
MIRAFLORES EAST DAM AND SPILLWAY—contd.							
Gates and caissons, fiscal year 1913 (total).....	<i>Cu. yds.</i>	\$40,625.69				\$40,625.69	
Operating machinery, fiscal year 1913 (total).....		64,299.22		\$1,346.32		65,645.54	
Total Miraflores East Dam and Spillway.....		728,374.54		46,787.16		775,161.70	
MIRAFLORES WEST DAM.							
Dry excavation:							
May 4, 1904, to June 30, 1909.....	13,986	19,681.84	\$1.4073			19,681.84	\$1.4073
Fiscal year 1910.....	550	299.74	.5450	9.68	\$.0176	309.42	.5626
Fiscal year 1913.....	9,923	5,332.51	.5374	358.00	.0361	5,690.51	.5735
Total to June 30, 1913	24,459	25,314.09	1.0350	367.68	.0150	25,681.77	1.0500
Masonry:							
Fiscal year 1910.....		388.59		40.92		429.51	
Fiscal year 1912.....		84.97		7.83		92.80	
Fiscal year 1913.....	4,403	19,078.38	4.3330	1,808.26	.4107	20,886.64	4.7437
Total to June 30, 1913	4,403	19,551.94	4.4406	1,857.01	.4218	21,408.95	4.8624
Dry filling:							
May 4, 1904, to June 30, 1909.....	363,418	172,058.40	.4694	22,311.58	.0654	194,369.98	.5348
Fiscal year 1910.....	157,483	106,686.04	.6774	12,828.58	.0815	119,514.62	.7589
Fiscal year 1911.....	295,598	121,256.20	.4102	8,806.63	.0298	130,062.83	.4400
Fiscal year 1912.....	425,125	171,936.88	.4044	8,267.23	.0195	180,204.11	.4239
Fiscal year 1913.....	418,375	170,546.97	.4076	11,688.63	.0280	182,235.60	.4356
Total to June 30, 1913	1,659,999	742,484.49	.4473	63,902.65	.0385	806,387.14	.4858
Hydraulic filling:							
Fiscal year 1910.....		3,665.16		412.70		4,077.86	
Fiscal year 1911.....		16,674.85		1,987.59		18,662.44	
Fiscal year 1912.....		10,094.39		895.46		10,989.85	
Fiscal year 1913.....		18,376.34		854.45		19,230.79	
Total to June 30, 1913		48,810.74		4,150.20		52,960.94	
Total Miraflores West Dam.....		836,161.26		70,277.54		906,438.80	
MIRAFLORES LOCKS.							
Dry excavation:							
Diversions, fiscal year 1910 (total).....	5,885	2,028.98	.3448			2,028.98	.3448
In lock site:							
May 4, 1904, to June 30, 1909.....	1,120,342	910,973.87	.8131	164,599.98	.1469	1,075,573.85	.9600
Fiscal year 1910.....	229,793	303,825.88	1.3222	42,925.57	.1868	346,751.45	1.5090
Fiscal year 1911.....	247,700	182,758.81	.7378	17,645.43	.0712	200,404.24	.8090
Fiscal year 1912.....	624,747	410,197.14	.6566	31,729.05	.0508	441,926.19	.7074
Fiscal year 1913.....				1,367.28		1,367.28	
Total to June 30, 1913	2,222,582	1,807,755.70	.8133	255,532.75	.1150	2,063,288.45	.9283
Dredging excavation:							
May 4, 1904, to June 30, 1909.....	167,888	57,408.31	.3418	6,587.95	.0393	63,996.26	.3811
Fiscal year 1910.....	141,759	71,784.25	.5063	6,599.15	.0466	78,383.40	.5529
Total to June 30, 1913	309,647	129,192.56	.4172	13,187.10	.0426	142,379.66	.4598

## EXHIBIT A.—STATEMENT OF CONSTRUCTION EXPENDITURES TO JUNE 30, 1913—Contd.

TABLE 3.—Statement of construction expenditures to June 30, 1913—Continued.

## PACIFIC DIVISION—Continued.

	Quantities.	Total division expenses, including arbitrary for plant.		Administrative and general expenses.		Total cost.	
		Amount.	Unit cost.	Amount.	Unit cost.	Amount.	Unit cost.
MIRAFLORES LOCKS—con.							
Hydraulic excavation, fiscal year 1911 (total)...	<i>Cu. yds.</i> 332,703	\$182,526.79	\$0.5486	\$12,772.23	\$0.0384	\$195,299.02	\$0.5870
Preparing foundations:							
Excavation—							
Fiscal year 1910...	64,036	124,669.74	1.9469	15,952.08	.2491	140,621.82	2.1960
Fiscal year 1911...	137,752	221,569.09	1.6085	27,351.86	.1985	248,920.95	1.8070
Fiscal year 1912...	165,145	258,894.68	1.5677	23,853.75	.1444	282,748.43	1.7121
Fiscal year 1913...	49,048	109,653.13	2.2356	11,172.19	.2278	120,825.32	2.4634
Total to June 30, 1913.....	415,981	714,786.64	1.7183	78,329.88	.1883	793,116.52	1.9066
Wooden piling (linear feet)—							
Fiscal year 1912...	6,580	50,264.36	7.6390	3,582.18	.5444	53,846.54	8.1834
Fiscal year 1913...	38,125	5,988.22	.1571	663.92	.0174	6,652.14	.1745
Total to June 30, 1913.....	44,705	56,252.58	1.2583	4,246.10	.0950	60,498.68	1.3533
Masonry:							
Concrete, plain—							
Fiscal year 1910...	1,630	12,050.56	7.3929	1,173.62	.7200	13,224.18	8.1129
Fiscal year 1911...	272,933	1,278,048.03	4.6826	85,998.07	.3151	1,364,046.10	4.9977
Fiscal year 1912...	729,096	3,344,155.62	4.5867	163,283.44	.2240	3,507,441.06	4.8107
Fiscal year 1913...	402,607	2,024,007.36	5.0273	148,806.91	.3696	2,172,814.27	5.3969
Total to June 30, 1913.....	1,406,266	6,658,261.57	4.7347	399,264.04	.2839	7,057,525.61	5.0186
Concrete, reenforced—							
Fiscal year 1912...	22,444	238,776.94	10.6388	18,341.91	.8172	257,118.85	11.4560
Fiscal year 1913...	48,185	520,508.01	10.8023	50,962.64	1.0576	571,470.65	11.8599
Total to June 30, 1913.....	70,629	759,284.95	10.7503	69,304.55	.9813	828,589.50	11.7316
Total masonry.....	1,476,895	7,417,546.52	5.0224	468,568.59	.3173	7,886,115.11	5.3397
Ironwork:							
Fiscal year 1910.....		92,950.46		2,490.41		95,440.87	
Fiscal year 1911.....		413,153.74		34,433.35		447,587.09	
Fiscal year 1912.....		232,241.41		29,325.29		261,566.70	
Fiscal year 1913.....		123,017.79		634.49		123,652.28	
Total to June 30, 1913.....		861,363.40		66,883.54		928,246.94	
Gates:							
Fiscal year 1912.....		129,400.09		22,899.20		152,299.29	
Fiscal year 1913.....		1,104,445.28		5,253.34		1,099,191.94	
Total to June 30, 1913.....		1,233,845.37		17,645.86		1,251,491.23	
Emergency dams, fiscal year 1913 (total).....		38,803.75		553.69		39,357.44	
Operating machinery:							
Fiscal year 1912.....		160,565.32		6,494.50		167,059.82	
Fiscal year 1913.....		1,290,340.70		38,737.52		1,329,078.22	
Total to June 30, 1913.....		1,450,906.02		45,232.02		1,496,138.04	
Concrete in machinery installation, fiscal year 1913 (total).....	9,814	110,911.38	11.3013	8,747.01	.8913	119,658.39	12.1926
Buffer timbers, fiscal year 1913 (total).....		6,169.10		816.03		6,985.13	



## EXHIBIT A.—STATEMENT OF CONSTRUCTION EXPENDITURES TO JUNE 30, 1913—Contd.

TABLE 3.—Statement of construction expenditures to June 30, 1913—Continued.

## PACIFIC DIVISION—Continued.

	Quantities.	Total division expenses, including arbitraries for plant.		Administrative and general expenses.		Total cost.	
		Amount.	Unit cost.	Amount.	Unit cost.	Amount.	Unit cost.
MIRAFLORES LOCKS—CON.							
Back fill:							
May 4, 1904, to June 30, 1909.....	<i>Cu. yds.</i> 409,211	\$36,801.83	\$0.0899	\$6,246.87	\$0.0158	\$43,048.70	\$0.1052
Fiscal year 1910.....	121,080	52,170.32	.4309	6,741.18	.0557	58,911.50	.4866
Fiscal year 1911.....	53,521	22,976.42	.4293	2,557.17	.0478	25,533.59	.4771
Fiscal year 1912.....	442,774	184,794.90	.4174	11,574.39	.0261	196,369.29	.4435
Fiscal year 1913.....	979,468	398,448.50	.4068	32,474.60	.0362	430,923.10	.4400
Total to June 30, 1913.	2,006,054	695,191.97	.3466	59,594.21	.0297	754,786.18	.3763
Filling center wall:							
Fiscal year 1912.....	7,912	8,011.43	1.0126	403.09	.0509	8,414.52	1.0635
Fiscal year 1913.....	149,301	89,174.58	.5973	6,027.48	.0404	95,202.06	.6377
Total to June 30, 1913.....	157,213	97,186.01	.6182	6,430.57	.0409	103,616.58	.6591
Total Miraflores locks.....		14,804,466.77		1,038,539.58		15,843,006.35	
Total Miraflores locks and dams.....		16,369,002.57		1,155,604.28		17,524,606.85	
LA BOCA LOCKS AND DAMS. <sup>1</sup>							
Dry excavation, May 4, 1904, to June 30, 1909 (total).....	78,233	131,254.40	1.6777	27,088.89	.3463	158,343.29	2.0240
Construction:							
Dam, May 4, 1904, to June 30, 1909 (total).....		288,601.56		26,748.51		315,350.07	
Locks, May 4, 1904, to June 30, 1909 (total).....		145,828.37		13,478.03		159,306.40	
Total La Boca locks and dams.....		565,684.33		67,315.43		632,999.76	
Total lower locks and dams Pacific entrance.....		16,934,686.90		1,222,919.71		18,157,606.61	
Plant:							
Amount to be absorbed after June 30, 1913.....		75,068.96				75,068.96	
Total.....		17,009,755.86		1,222,919.71		18,232,675.57	
NAOS ISLAND BREAK-WATER. <sup>2</sup>							
Dry filling:							
Fiscal year 1910.....	782,021	36,847.73	.2467	20.03		36,867.76	.2467
Fiscal year 1911.....		21,238.30			21,238.30		
Fiscal year 1912.....		134,839.41			134,839.41		
Fiscal year 1913.....		191,615.45		.2934	20,539.96	.0314	
Total to June 30, 1913.	1,435,158	384,540.89	.2680	20,559.99	.0143	405,100.88	.2823
MANUFACTURING PLANTS.							
Amounts to be absorbed after June 30, 1913:							
Electric power plant.....		174,485.60				174,485.60	
Ancon rock quarry.....		109,046.68				109,046.68	
Chame sand plant.....		3,753.24				3,753.24	
Total.....		287,285.52				287,285.52	
Total Pacific division.....		42,263,458.17		2,965,396.90		45,228,855.07	

<sup>1</sup> Subsequently abandoned owing to change of plans.<sup>2</sup> Constructed by central division. Charges represent extra cost of dumping material at this point.

## EXHIBIT A.—STATEMENT OF CONSTRUCTION EXPENDITURES TO JUNE 30, 1913—Contd.

TABLE 4.—Statement of construction expenditures to June 30, 1913.

## BALBOA TERMINAL FACILITIES.

	Quantities.	Total division expenses, including arbitraries for plant.		Administrative and general expenses.		Total cost.	
		Amount.	Unit cost.	Amount.	Unit cost.	Amount.	Unit cost.
<b>Preliminary work:</b>	<i>Cu. yds.</i>						
Fiscal year 1911.....		\$16,277.26		\$2,114.44		\$18,391.70	
Fiscal year 1912.....		1,175.16		257.48		917.68	
Fiscal year 1913.....		13,326.59		1,476.67		14,803.26	
Total to June 30, 1913.....		28,428.69		3,848.59		32,277.28	
<b>Preparing site:</b>							
Miscellaneous—							
Fiscal year 1911.....		4,547.08		478.49		5,025.57	
Fiscal year 1912.....		27,200.94		1,004.22		28,205.16	
Fiscal year 1913.....		135,879.24		7,914.80		143,794.04	
Total to June 30, 1913.....		167,627.26		9,397.51		177,024.77	
<b>Excavation—</b>							
Fiscal year 1912.....	23,140	19,785.26	\$0.8550	1,687.36	\$0.0729	21,472.62	\$0.9279
Fiscal year 1913.....	389,567	212,172.31	.5447	15,554.56	.0399	227,726.87	.5846
Total to June 30, 1913.....	412,707	231,957.57	.5620	17,241.92	.0418	249,199.49	.6038
<b>Filling—</b>							
Fiscal year 1912.....	23,140	10,739.54	.4641	826.56	.0357	11,566.10	.4998
Fiscal year 1913.....	482,279	191,024.53	.3961	12,207.78	.0253	203,232.31	.4214
Total to June 30, 1913.....	505,419	201,764.07	.3992	13,034.34	.0258	214,798.41	.4250
Total preparing site.....		601,348.90		39,673.77		641,022.67	
<b>Yards and tracks:</b>							
Fiscal year 1912.....		6,421.98		601.57		7,023.55	
Fiscal year 1913.....		8,629.63		790.64		9,420.27	
Total to June 30, 1913.....		15,051.61		1,392.21		16,443.82	
<b>Dredging inner basin:</b>							
Fiscal year 1912.....	370,607	58,549.14	.1580	5,594.70	.0151	64,143.84	.1731
Fiscal year 1913.....	1,401,207	215,567.78	.1538	19,887.36	.0142	235,455.14	.1680
Total to June 30, 1913.....	1,771,814	274,116.92	.1547	25,482.06	.0144	299,598.98	.1691
<b>Main dry dock:</b>							
Preliminary work—							
Fiscal year 1911.....		1,563.65		192.16		1,755.81	
Fiscal year 1912.....		10,157.81		921.13		11,078.94	
Fiscal year 1913.....		7,938.81		84.73		8,023.54	
Total to June 30, 1913.....		19,660.27		1,198.02		20,858.29	
Excavation, fiscal year 1913 (total).....	145,478	123,087.95	.8461	7,049.93	.0485	130,137.88	.8946
Gates, fiscal year 1913 (total).....		756.25		97.01		853.26	
Total main dry dock.....		143,504.47		8,344.96		151,849.43	
<b>Coaling plant:</b>							
Preliminary work—							
Fiscal year 1912.....		1,237.89		124.16		1,362.05	
Fiscal year 1913.....		1,034.86		58.39		1,093.25	
Total to June 30, 1913.....		2,272.75		182.55		2,455.30	
Excavation, fiscal year 1913 (total).....	58,221	49,260.40	.8461	2,821.42	.0485	52,081.82	.8946
Total coaling plant.....		51,533.15		3,003.97		54,537.12	
Sea wall, preliminary work, fiscal year 1913 (total).....		2.73		.26		2.99	

## EXHIBIT A.—STATEMENT OF CONSTRUCTION EXPENDITURES TO JUNE 30, 1913—Contd.

TABLE 4.—Statement of construction expenditures to June 30, 1913—Continued.

## BALBOA TERMINAL FACILITIES—Continued.

	Quantities.	Total division expenses, including arbitraries for plant.		Administrative and general expenses.		Total cost.	
		Amount.	Unit cost.	Amount.	Unit cost.	Amount.	Unit cost.
PERMANENT SHOPS.							
Preliminary work:	Cu. yds.						
Fiscal year 1912.....		\$3,653.35				\$3,653.35	
Fiscal year 1913.....		36,748.78		\$1,565.92		38,314.70	
Total to June 30, 1913.....		40,402.13		1,565.92		41,968.05	
Foundations:							
Excavation, fiscal year 1913 (total)....	29,684	46,327.41	\$1.5607	4,862.25	\$0.1638	51,189.66	\$1.7245
Masonry, fiscal year 1913 (total)....	7,787	71,711.24	9.2091	6,829.40	.8770	78,540.64	10.0861
Wooden piles (linear feet), fiscal year 1913 (total)....	135,442	65,279.78	.4820	8,559.43	.0632	73,839.21	.5452
Concrete piles (linear feet), fiscal year 1913 (total)....	3,060	9,901.53	3.2358	226.21	.0739	10,127.74	3.3097
4-foot caissons (linear feet), fiscal year 1913 (total)....	315	4,701.45	14.9252	170.03	.5398	4,871.48	15.4650
3-foot caissons, fiscal year 1913 (total)....		422.08				422.08	
9-inch steel tubing, fiscal year 1913 (total)....		108.56				108.56	
Back filling, fiscal year 1913 (total)....	4,338	3,305.16	.7619	94.89	.0219	3,400.05	.7838
Total foundations.....		201,757.21		20,742.21		222,499.42	
Floors, fiscal year 1913 (total).....							
		4,781.69				4,781.69	
Steel erection, fiscal year 1913 (total)....		15,706.86		1,357.98		17,064.84	
Superstructure, fiscal year 1913 (total)....		1,511.55				1,511.55	
Roofs, fiscal year 1913 (total).....		448.25				448.25	
Machine installation, fiscal year 1913 (total)....		5,467.55		332.59		5,800.14	
Miscellaneous, fiscal year 1913 (total)....		5,176.81		276.62		5,453.43	
Total permanent shops.....		275,252.05		24,275.32		299,527.37	
DOCKS.							
Preliminary work:							
Fiscal year 1912.....		3,653.35				3,653.35	
Fiscal year 1913.....		25,460.42		2,240.68		27,701.10	
Total to June 30, 1913.....		29,113.77		2,240.68		31,354.45	
Excavation for piers, fiscal year 1913 (total)....	28,834	79,807.36	2.7678	6,386.41	.2215	86,193.77	2.9893
Concrete:							
Caisson shells, fiscal year 1913 (total)....	9,446	121,124.81	12.8228	10,855.85	1.1493	131,980.66	13.9721
Caisson filling, fiscal year 1913 (total)....	3,914	28,752.54	7.3461	2,173.56	.5553	30,926.10	7.9014
Total concrete.....	13,360	149,877.35	11.2184	13,029.41	.9752	162,906.76	12.1936
Concrete floor system, fiscal year 1913 (total)....		30,379.91		4,053.47		34,433.38	
Miscellaneous, fiscal year 1913 (total)....		1,977.26				1,977.26	
Total docks.....		291,155.65		25,709.97		316,865.62	

## EXHIBIT A.—STATEMENT OF CONSTRUCTION EXPENDITURES TO JUNE 30, 1913—Contd.

TABLE 4.—Statement of construction expenditures to June 30, 1913—Continued.

## BALBOA TERMINAL FACILITIES—Continued.

	Quantities.	Total division expenses, including arbitraries for plant.		Administrative and general expenses.		Total cost.	
		Amount.	Unit cost.	Amount.	Unit cost.	Amount.	Unit cost.
DOCKS—continued.							
Fuel-oil tanks, fiscal year 1913 (total).....		\$2,676.18		\$24.41		\$2,700.59	
Total terminal facilities, Balboa.....		1,683,070.35		131,755.52		1,814,825.87	
Plant, amount to be absorbed after June 30, 1913.....		260,900.74				260,900.74	
Total.....		1,943,971.09		131,765.52		2,075,726.61	

TABLE 5.—Statement of construction expenditures to June 30, 1913.

## MISCELLANEOUS.

	Quantities.	Total division expenses, including arbitraries for plant.		Administrative and general expenses.		Total cost.	
		Amount.	Unit cost.	Amount.	Unit cost.	Amount.	Unit cost.
Permanent town sites, Balboa, fiscal year 1913 (total).....		\$45,807.55		\$3,535.70		\$49,343.25	
Permanent buildings:							
Designing, fiscal year 1913 (total).....		20,445.51				20,445.51	
Administration building, fiscal year 1913 (total).....		32,976.61		1,319.31		34,295.92	
Laborers' quarters, Balboa, fiscal year 1913 (total).....		9,147.86				9,147.86	
Total permanent buildings.....		62,569.98		1,319.31		63,889.29	
Plant, amount to be absorbed after June 30, 1913.....		5,273.19				5,273.19	
Total.....		67,843.17		1,319.31		69,162.48	
Lights and buoys:							
Fiscal year 1911.....		12,055.85		2,319.03		14,374.88	
Fiscal year 1912.....		102,364.12		9,255.81		111,619.93	
Fiscal year 1913.....		235,738.81		8,751.46		244,490.27	
Total to June 30, 1913.....		350,158.78		20,326.30		370,485.08	
Plant, amount to be absorbed after June 30, 1913.....		26,882.85				26,882.85	
Total.....		377,041.63		20,326.30		397,367.93	
Power transmission line, fiscal year 1913 (total).....		13,214.33		801.30		14,015.63	
Plant, amount to be absorbed after June 30, 1913.....		1,382.90				1,382.90	
Total.....		14,597.23		801.30		15,398.53	
Trans-Isthmian oil line, fiscal year 1913 (total).....		32,051.64		3.05		32,054.69	
Total construction costs.....		170,779,345.64		14,536,750.11		185,316,095.75	

NOTE.—Quantities shown are cubic yards, except where noted.

## EXHIBIT B.—DETAIL COST PER UNIT OF WORK BY MONTHS—FISCAL YEAR 1913.

TABLE 1.—*Dry excavation.*

## ATLANTIC DIVISION.

Items.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	Total.
<b>GATUN SPILLWAY.</b>													
Preparing foundations, excavation, cubic yards.....			175										175
Loading by power.....			\$1.4478										\$1.4478
Confordams.....													.8148
Division expense.....			.1287										.1287
Total division cost.....			1.5765										2.3913
Administrative and general expense.....			.1802										.7574
Total cost.....			1.7567										3.1487
<b>GATUN LOCKS.</b>													
Dry excavation.....cubic yards.							40,538		35,616	26,949	1,329	228	104,660
Drilling.....							\$0.0203		\$0.0281	\$0.0145	\$0.0684		\$0.0378
Blasting.....							.0018		.0117	.0093	.2468		.0147
Loading by power.....							.0560		.0431	.0357	2.0833		.0825
Tracks.....							.0942		.0597	.0650	2.1444	\$4.4090	.1328
Transportation.....							.1664		.1396	.1275	.2621		.1481
Pumps.....							.0406		.0529	.0330	.8409	2.1731	.0767
Maintenance of equipment.....							.0608		.0414	.1228	.2062	.1080	.0807
Division expense.....							.0280		.0078	.0123	.3156	.5108	.0308
Total division cost.....							.4681		.3843	.4401	6.1197	7.2069	.6041
Administrative and general expense.....							.0404		.0177	.0179	.4473	.6160	.0477
Total cost.....							.5085		.4020	.4580	6.5670	7.8229	.6518
Preparing foundations, excavation, cubic yards.....					1,353	15,215	4,954	8,851	357	2,333			33,063
Drilling.....						\$0.0147							\$0.0067
Blasting.....						.0429							.0197
Loading by power.....					\$3.1226	.1313	\$0.4224	\$0.1318	\$1.0122				.2977
Loading by hand.....					1.1069	.7041	.7821	.7821	1.7690	\$0.9657			.5352
Transportation.....					.3172	.1280	.0419	.2549	.2943				.1384

EXHIBIT B.—DETAIL COST PER UNIT OF WORK BY MONTHS—FISCAL YEAR 1913—Continued.  
TABLE 1.—*Dry excavation*—Continued.  
ATLANTIC DIVISION—Continued.

Items.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	Total.
GATUN LOCKS—continued.													
Preparing foundations, excavation—Con.													
Trucks.....					\$0. 3400	\$0. 0652	\$0. 9105	\$0. 3400	\$3. 7877				\$0. 3155
Pumps.....								.1499					.0401
Maintenance of equipment.....					.9724	.0909	.2193	.4047	1. 5429	\$0. 0898			.2486
Division expense.....					.4633	.6384	.1508	.1007	.6013	.0935			.0993
Total division cost.....					6. 3214	.7097	2. 4490	2. 1341	9. 0074	1. 1390			1. 7012
Administrative and general expense.....					.6355	.0791	.2473	.2125	1. 3085	.1543			.1813
Total cost.....					6. 9569	.7883	2. 6965	2. 3466	10. 3159	1. 2933			1. 8825
PERMANENT POWER HOUSE—GATUN.													
Dry excavation..... cubic yards..	14, 948												14, 948
Drilling.....	\$0. 0150												\$0. 0150
Blasting.....	.0136												.0136
Loading.....	.0414												.0414
Trucks.....	.1823												.1823
Transportation.....	.0589												.0589
Maintenance of equipment.....	.0351												.0351
Division expense.....	.0237												.0237
Total division cost.....	.3700												.4022
Administrative and general expense.....	.0318												.0360
Total cost.....	.4018												.4382
Preparing foundations..... cubic yards..	3, 809	1, 974	850	1, 700	850	1, 462	250	30	89	10	500	160	11, 684
Drilling.....	\$0. 1436				\$0. 0089	\$0. 0290	\$0. 1783	\$3. 9790					\$0. 0448
Blasting.....	.0123	.0198		\$0. 0038	.0272	.1753	.0067	.2640					.0177
Loading by power.....	.3720	.2172	.1239	.1239	.2621	.1333	1. 8333	1. 4663	\$0. 4573			\$0. 0838	.2003
Loading by hand.....	.3040	.6422	1. 3086	1. 4868	2. 1210	.9408	2. 4701	17. 9447	7. 3987	\$15. 7110	\$11. 2522	1. 8062	1. 0327
Trucks.....	.0417	.0950	.2138	.0662	.1059	.2959	.1489	4. 5700	3. 2108	1. 3250	10. 0714	.1030	.1800
Transportation.....						.3299	1. 4397				.0038		.0319
Maintenance of equipment.....	.0218	.1024	.1540	.1068	.1044	.1581	.7145	.7890	.1635	27. 9720			.1209
Coferdams.....				.1364									.0199
Division expense.....	.0415	.1244	.1609	.2279	.2084	.1527	.2998	1. 7287	.6382	8. 9110	1. 0646	.2358	1. 1491
Total division cost.....	.4757	1. 4919	2. 1550	2. 1508	2. 8979	2. 0817	5. 0830	30. 7217	11. 8685	52. 2690	22. 3920	2. 2288	1. 7973

Administrative and general expense . . . . .	.0480	.1448	.2361	.1775	.3059	.2906	.4368	3.4353	1.2810	12.3870	1.2998	.2776	.1821
Total cost . . . . .	.5237	1.6367	2.3911	2.3933	3.2038	2.3123	5.5198	34.1570	13.1495	64.6560	23.6918	2.5064	1.9794

## CENTRAL DIVISION.

PRISM.													
Dry excavation—cubic yards . . . . .	1,336,366	1,094,132	922,712	1,113,420	973,071	1,074,510	1,135,580	996,800	1,183,900	1,178,000	921,000	808,069	12,737,500
Drilling . . . . .	\$0.0561	\$0.0614	\$0.0620	\$0.0657	\$0.0691	\$0.0691	\$0.0595	\$0.0600	\$0.0513	\$0.0451	\$0.0482	\$0.0446	\$0.0570
Blasting . . . . .	.0578	.0617	.0466	.0514	.0532	.0534	.0533	.0460	.0450	.0398	.0416	.0427	.0439
Loading . . . . .	.0814	.0857	.0820	.0850	.0866	.0826	.0824	.0812	.0810	.0809	.0805	.0774	.0878
Tracks . . . . .	.0703	.0875	.0800	.0912	.1005	.0959	.1046	.1087	.0910	.0978	.1157	.1342	.0967
Transportation . . . . .	.0655	.1014	.0994	.1015	.0879	.0806	.0814	.0901	.0937	.0845	.1168	.1319	.0933
Dumps . . . . .	.0436	.0889	.0648	.0807	.0697	.0632	.0631	.0604	.0603	.0634	.0733	.0645	.0577
Pumps . . . . .	.0666	.0138	.0385	.0147	.0385	.0367	.0361	.0369	.0369	.0360	.0218	.0363	.0690
Maintenance of equipment . . . . .	.6937	.1015	.1147	.1075	.1277	.1118	.1131	.1306	.1063	.1241	.1235	.1250	.1140
Plant arbitrary . . . . .	.0075	.0075	.0075	.0075	.0075	.0075	.0075	.0075	.0075	.0075	.0075	.0075	.0020
Division expense . . . . .	.0134	.0187	.0115	.0140	.0142	.0114	.0109	.0128	.0117	.0087	.0128	.0192	.0131
Total division cost . . . . .	.4709	.5631	.5636	.5455	.5915	.5350	.5352	.5797	.4991	.5183	.6282	.6678	.5525
Administrative and general expense . . . . .	.0227	.0351	.0406	.0186	.0400	.0372	.0379	.0415	.0310	.0340	.0430	.0559	.0355
Total cost . . . . .	.4936	.6032	.6042	.5641	.6315	.5722	.5761	.6212	.5301	.5523	.6712	.7237	.5880

## PACIFIC DIVISION.

PRISM.													
Dry excavation—cubic yards . . . . .	152,555	183,570	143,008	219,959	237,578	302,418	407,967	331,778	366,000	375,080	261,014	229,894	3,210,851
Clearing . . . . .	\$0.1005	\$0.1164	\$0.0488	\$0.0926	\$0.0949	\$0.0745	.0496	.0443	\$0.0223	\$0.0414	\$0.0585	\$0.0561	\$0.0004
Drilling . . . . .	.0453	.0588	.0239	.0317	.0099	.0092	.0229	.0220	.0403	.0101	.0108	.1186	.0307
Blasting . . . . .	.1038	.0987	.1569	.0979	.0947	.0909	.0694	.0802	.0784	.0812	.0780	.0846	.0878
Loading . . . . .	.1328	.2406	.2485	.2121	.2147	.1815	.1104	.1825	.1737	.1284	.1457	.1214	.1662
Tracks . . . . .	.0426	.1024	.1272	.0980	.1014	.0926	.0691	.0983	.0926	.0748	.0837	.0661	.0862
Transportation . . . . .	.0001	.0179	.0166	.0192	.0142	.0184	.0166	.0241	.0254	.0172	.0246	.0203	.0188
Dumps . . . . .	.0869	.0329	.0745	.0349	.0377	.0227	.0196	.0148	.0084	.0301	.0335	.0461	.0297
Pumps . . . . .	.0546	.0006	.1114	.1018	.0707	.0900	.0638	.0964	.0787	.0418	.0823	.0561	.0758
Maintenance of equipment . . . . .	.0700	.0703	.0703	.0702	.0701	.0701	.0940	.0900	.0900	.0900	.0900	.0900	.0834
Plant arbitrary . . . . .	.0271	.0283	.0304	.0376	.0285	.0195	.0161	.0180	.0198	.0209	.0218	.0204	.0232
Total division cost . . . . .	.6337	.8569	.9085	.7960	.7368	.6694	.5298	.6723	.6296	.5309	.6289	.6877	.6622
Administrative and general expense . . . . .	.0423	.0572	.0750	.0506	.0625	.0640	.0252	.0376	.0341	.0444	.0499	.0555	.0464
Total cost . . . . .	.6760	.9141	.9835	.8466	.7993	.7234	.5550	.7099	.6637	.5753	.6788	.7432	.7086

1 Bold-face type indicates credit.

## EXHIBIT B.—DETAIL COST PER UNIT OF WORK BY MONTHS—FISCAL YEAR 1913—Continued.

TABLE 1.—*Dry excavation*—Continued.

## PACIFIC DIVISION—Continued.

Items.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	Total.
<b>PEDRO MIGUEL LOCKS.</b>													
Dry excavation—cubic yards.....	3,044												3,044
Loading by power.....	\$0.1183												\$0.1183
Tracks.....	.1068												.1068
Transportation.....	.0610												.0610
Pumps.....	.0343												.0343
Maintenance of equipment.....	.0639												.0639
Division expense.....	.0235												.0235
Total division cost.....	.4078												.4078
Administrative and general expense.....	.0433												.0204
Total cost.....	.4511												.4282
<b>Preparing foundations, excavation—cubic yards.</b>													
Drilling.....	1,094	4,930	593	1,037	2,352	2,117	1,248	448	800	620	127		15,366
Blasting.....	\$0.4932	\$0.1132	\$1.4343	\$0.3511	\$0.0667	\$0.3587	\$0.2805			\$0.0142			\$0.2334
Loading by power.....	.1596	.0798	.1855	.4496	.0818	1,1929	.7063						.0701
Tracks.....	.1274	.0621			.0757	.1084	.4763						.0616
Transportation.....	2,1302	.3863	2,3172	2,3196	1,0901	.3624	.3924	\$0.2612	\$1.3312	2,0847	\$8.2562		1,0020
Pumps.....	.0928	.0351	1471	4544	.1124	.1318	.0187	1,710	.0338	.1573	.6684		.1042
Division expense.....	.2022	.1122	.3097	.3292	.2201	.2314	.7667	1,3413	.3793		18,1721		.4725
Maintenance of equipment.....	.0341	.0106	.1134	.0579	.0528	.1482	.0191	.0284	.0141	.0158	.0508		.0026
Division expense.....	.3754	.0764	.3019	.6275	.3058	.2115	.3761	.0885	.3016	.3352	1,2617		.0497
Total division cost.....	.2094	.0675	.2177	.3083	.0675	.0671	.1011	.5330	.0976	.1935	.5288		.1313
Administrative and general expense.....	3,8243	.9604	5,1168	4,8976	2,1029	1,4966	2,0688	2,4334	2,1576	3,4691	28,2696		2,3885
Total cost.....	.4076	.1535	.6246	1,1049	.2267	.1979	.2401	.5283	.1320	.3557	2,6258		.2531
<b>MIRAFLORES LOCKS.</b>													
Preparing foundations, excavation—cubic yards.....	5,442	6,210	3,859	4,464	5,594	10,002	7,632	2,355	3,100	390			49,048
Drilling.....	\$0.0193	\$0.0218		\$0.0145	\$0.0088	\$0.0015	\$0.0011	\$0.0148	\$0.1965				\$0.0208
Blasting.....	.0101				.0064	.0624	.1315	.5366	.1315				.0524



Leading by power.....	.0200	\$1.9027	1.5636	1.4234	.0362	1.0153	2.0588	1.0387	\$4.9732	.0025
Leading by hand.....	2.1754	.0079	.0018	.0031	.0031	.0031	.0031	.0184	.6735	1.4229
Transportation.....	.0316	.0079	.0018	.0031	.0031	.0031	.0031	.0184	.0374	.0374
Tracks.....	.0674	.3543	.1806	.2337	.0760	.1256	.0156	.3579	.6268	.1663
Pumps.....	.1915	.2814	.1719	.0676	.0719	.0196	.0128	.0048	.0272	.1050
Confederates.....	.2033				.0248					
Maintenance of equipment.....	.1113	.1083	.1683	.1131	.0248	.0709	.2445	.1637	.3114	.1448
Plant arbitrary.....	.2104	.2104	.2102	.2101	.2100	.0300	.0300	.0300	.1606	.1606
Division expense.....	.1173	.1447	.1772	.1347	.0738	.0732	.1588	.1248	.4618	.1229
Total division cost.....	2.9912	3.0097	2.5181	2.2945	1.7593	1.4612	3.0933	2.6063	7.1039	2.2556
Administrative and general expense.....	.2794	.2357	.0926	.2456	.1702	.1179	.4028	.2114	2.4576	.2278
Total cost.....	3.2706	3.3054	2.6107	2.4701	1.9295	1.5791	3.4961	2.8777	9.5615	2.4834
PEDRO MIGUEL DAM.										
Excavation—cubic yards.....	274	956	220	45	665	304				2,464
Excavation by hand.....			\$3.2140	\$9.9847	\$1.4250	\$1.1960				\$2.3712
Maintenance of equipment.....			1.0260	.8227	.2875	.0004				.2332
Division expense.....	\$0.0948	\$0.1060	.7495	.7411	.0640	.0679				.1989
Total division cost.....	2.0237	1.9307	9.9895	11.5485	1.7795	1.2643				2.8233
Administrative and general expense.....	.1901	.1894	.8117	1.1380	.1668	.0921				.2598
Total cost.....	2.2138	2.1201	10.8012	12.6865	1.9463	1.3564				3.0831
MIRAFLORES WEST DAM.										
Dry excavation..... cubic yards.....		1,333		530					8,060	9,923
Excavation.....		\$0.9429		\$1.6372					\$0.1027	\$0.3327
Transportation.....									.0644	.0523
Tracks.....									.0181	.0147
Pumps.....									.0272	.0220
Maintenance of equipment.....									.0319	.0259
Plant arbitrary.....		.2100		.2100					.0300	.0638
Division expense.....		.0573		.1268					.0117	.0260
Total division cost.....		1.2102		1.9740					.2800	.5374
Administrative and general expense.....		.0955		.0795					.0189	.0361
Total cost.....		1.3057		2.0535					.3049	.5735

1 Bold-face type indicates credit.

## EXHIBIT B.—DETAIL COST PER UNIT OF WORK BY MONTHS—FISCAL YEAR 1913—Continued.

TABLE 1.—Dry excavation—Continued.

## PACIFIC DIVISION—Continued.

Items.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	Total.
MIRAFLORES EAST DAM AND SPILLWAY.													
Dry excavation.....cubic yards.			3,000	7,206	790	4,769	6,375	10,177	25,600	14,805	3,778		76,500
Drilling.....						\$0.1900	\$0.2140	\$0.2664	\$0.1057	\$0.1368	\$0.4491		\$0.1492
Blasting.....							.0227	.0461	.0803	.0963	.1171		.0594
Excavation by power.....							.1671		.0655	.0965	.0103		.0540
Excavation by hand.....			\$1.8375	\$0.2227		.8942	1.3512	1.4820	.5224	1.1068	2.6282		.9257
Excavation by pumps.....				.2368	.3119	.0015							.1288
Transportation.....						.0709	.1711	.1877	.1545	.1310	.1590		.2848
Tracks.....						.5663	.5983	.1527	.0687	.1701	.2331		.1328
Trestles.....						.3709	.4964	.2321	.1213	.0171	.0031		.1196
Pumps.....				.0014	.0968	.0962	.1290	.1578	.1100	.1641	.1326		.1612
Maintenance of equipment.....			.0300	.0783	.1596	.2617	.1664	.1630	.1350	.2066	.2287		.0612
Plant arbitrary.....			.1685	.1633	.2126	.2105	.0300	.0300	.0300	.0300	.0300		.1248
Division expense.....			.0530	.0416	.1714	.0892	.1278	.0384	.0679	.1230	.2226		.0878
Total division cost.....			3.1729	1.0729	2.9009	2.7519	3.4670	2.8102	1.4613	2.2441	4.1832		2.2993
Administrative and general expense.....			.1400	.0448	.2609	.2551	.2673	.1875	.0824	.2202	.7549		.2089
Total cost.....			3.3129	1.1177	3.1618	3.0070	3.7343	3.0037	1.5437	2.4643	4.9481		2.5082
Excavation by central division...cu. yds.							58,171						58,171
Cost.....							\$0.7038						\$0.7038
Total quantities.....cubic yards.			3,000	7,206	790	4,769	64,546	10,177	25,600	14,805	3,778		134,671
Total cost.....			\$3.3129	\$1.1177	\$3.1618	\$3.0070	\$1.0032	\$3.0037	\$1.5437	\$2.4643	\$4.9481		\$1.8093

Excavation by central division was accomplished during the months October, 1912, to January, 1913, inclusive.

## EXHIBIT B.—DETAIL COST PER UNIT OF WORK BY MONTHS—FISCAL YEAR 1913—Continued.

TABLE 2.—Dredging excavation.

## ATLANTIC DIVISION.

Items.	July.		August.		September.		October.		November.		December.	
	Quantities.	Unit cost.	Quantities.	Unit cost.	Quantities.	Unit cost.	Quantities.	Unit cost.	Quantities.	Unit cost.	Quantities.	Unit cost.
<b>PRISM.</b>												
Clearing.....	495,398	\$0.0003	429,415	\$0.0006	372,302	\$0.0284	308,631	\$0.0338	330,377	\$0.0296	246,765	\$0.0375
Operation, seagoing suction dredge.....	204,419	.0467	242,365	.0397	55,556	.0036	306,631	.0036	330,377	.0039	246,765	.0135
Repairs, seagoing suction dredge.....	204,419	.0047	242,365	.0142	55,556	.0036	306,631	.0036	330,377	.0039	246,765	.0135
Operation, small ladder dredges.....	72,173	.1124	88,056	.0912	82,594	.0904	55,315	.1138	45,359	.0738	39,769	.0942
Repairs, small ladder dredges.....	72,173	.0491	88,056	.0219	82,594	.0182	55,315	.1058	45,359	.0828	39,769	.0785
Operation, dipper dredges.....	13,323	.1480	4,966				13,829	.0772	35,719	.0828	47,071	.0785
Repairs, dipper dredges.....	13,323	.0659	98,994	.0963	234,132	.0547	196,708	.0737	260,612	.0610	480,768	.0619
Operation, pipe-line dredges.....	205,483	.0103	98,994	.0151	234,132	.0060	196,708	.0439	260,612	.0466	480,768	.0444
Repairs, pipe-line dredges.....	205,483	.0033	98,994	.0173	234,132	.0269	196,708	.0692	260,612	.0181	480,768	.0062
Dikes.....	85,496											
Operation, tugs, clappets, and scoops.....	85,496	.0881	88,056	.0668	82,594	.0860	69,144	.0841	79,258	.1109	86,840	.0834
Repairs, tugs, clappets, and scoops.....	85,496	.1091	88,056	.0856	82,594	.0469	69,144	.1083	79,258	.0922	86,840	.0834
Drilling.....	45,116	.0627	60,089	.0474	47,836	.0584	53,228	.0333	60,767	.0415	68,088	.0339
Blasting.....	45,116	.1557	60,089	.1117	47,836	.1175	53,228	.1328	60,767	.1070	68,088	.1006
Small boats.....	495,398	.0015	429,415	.0014	372,302	.0017	308,631	.0017	330,377	.0013	246,765	.0013
Repairs, miscellaneous equipment.....	495,398	.0015	429,415	.0014	372,302	.0014	308,631	.0014	330,377	.0013	246,765	.0009
Plant arbitrary.....	495,398	.0470	429,415	.0470	372,302	.0470	308,631	.0470	330,377	.0470	246,765	.0470
Division expense.....	495,398	.0075	429,415	.0070	372,302	.0085	308,631	.0085	330,377	.0065	246,765	.0049
Total division cost.....	495,398	.2076	429,415	.1925	372,302	.2403	308,631	.2403	330,377	.1707	246,765	.1567
Administrative and general expense.....	495,398	.0135	429,415	.0156	372,302	.0234	308,631	.0234	330,377	.0154	246,765	.0133
Total cost.....	495,398	.2211	429,415	.2081	372,302	.2637	308,631	.2637	330,377	.1861	246,765	.1700
Earth excavation.....	450,282	90.89	369,326	86.01	324,466	87.15	519,555	90.71	609,480	90.93	746,285	91.64
Rock excavation.....	45,116	13.91	60,089	13.99	47,836	12.85	53,228	12.85	60,767	9.07	68,088	8.36

Items.	January.		February.		March.		April.		May.		June.		Total.	
	Quantities.	Unit cost.	Quantities.	Unit cost.	Quantities.	Unit cost.	Quantities.	Unit cost.	Quantities.	Unit cost.	Quantities.	Unit cost.	Quantities.	Unit cost.
<b>PRISM.</b>														
Clearing.....	25,995	\$0.0314	19,430	\$0.0349	84,050	\$0.0314	99,859	\$0.0296	330,833	\$0.0302	341,576	\$0.0303	6,483,408	\$0.0001
Operation, seagoing suction dredge.....	32,483	1.2195	28,763	1.1905	34,709	.0628	48,374	.0628	55,054	.0619	48,131	.0619	2,288,676	.0348
Repairs, seagoing suction dredge.....	32,483	.1829	28,763	.2030	34,709	.2123	48,374	.2123	55,054	.2101	48,131	.2101	2,288,676	.0231
Operation, small ladder dredges.....	72,483	.1555	72,763	.0681	84,709	.0712	48,374	.0681	55,054	.0709	48,131	.0709	628,960	.1411
Repairs, small ladder dredges.....	72,483	.1144	72,763	.1047	84,709	.1113	48,374	.1047	55,054	.1068	48,131	.1068	628,960	.0948
Operation, dipper dredges.....	31,234	.0205	37,941	.1360	58,878	.0945	59,361	.0945	70,545	.1074	78,943	.1074	467,065	.1012
Repairs, dipper dredges.....	31,234	.0419	37,941	.0724	58,878	.0466	59,361	.0466	70,545	.0689	78,943	.0689	467,065	.0596
Operation, pipe-line dredges.....	308,606	.0011	217,315	.0079	202,605	.0044	228,811	.0044	228,711	.0244	345,942	.0244	3,698,707	.0300
Repairs, pipe-line dredges.....	308,606	.0011	217,315	.0079	202,605	.0044	228,811	.0044	228,711	.0244	345,942	.0244	3,698,707	.0300
Pipe lines.....	308,606	1.0063	217,315	.0381	202,605	.0132	228,811	.0132	228,711	.0260	345,942	.0114	3,698,707	.0062
Dikes.....	83,737	.1199	66,704	.1036	38,588	.0514	107,335	.1068	125,569	.0791	127,074	.1067	1,086,025	.0696
Operation, tugs, clappets, and scoops.....	83,737	.0613	66,704	.0778	38,588	.0349	107,335	.0349	125,569	.0210	127,074	.0349	1,086,025	.0676
Repairs, tugs, clappets, and scoops.....	83,737	.1076	66,704	.0457	38,588	.0349	107,335	.0349	125,569	.0210	127,074	.0349	1,086,025	.0676
Drilling.....	40,618	.1301	53,438	.1049	31,166	.1300	58,806	.0965	121,990	.0857	91,807	.0857	733,029	.1190
Blasting.....	40,618	.3302	53,438	.0029	38,588	.0022	436,005	.0025	685,163	.0049	814,592	.0049	6,483,408	.0017
Small boats.....	508,338	.0012	303,949	.0007	380,243	.0006	436,005	.0011	685,163	.0045	814,592	.0045	6,483,408	.0010
Repairs, miscellaneous equipment.....	508,338	.0312	303,949	.0310	380,243	.0310	436,005	.0310	685,163	.0310	814,592	.0310	6,483,408	.0349
Plant arbitrary.....	508,338	.0074	303,949	.0115	380,243	.0113	436,005	.0063	685,163	.0060	814,592	.0075	6,483,408	.0073
Division expense.....	508,338	.2212	303,949	.3605	380,243	.2274	436,005	.2781	685,163	.1014	814,592	.1730	6,483,408	.2003
Total division cost.....	508,338	.0214	303,949	.0472	380,243	.0537	436,005	.0167	685,163	.0144	814,592	.0090	6,483,408	.0167
Administrative and general expense.....	508,338	.2426	303,949	.4077	380,243	.2611	436,005	.2948	685,163	.2058	814,592	.1829	6,483,408	.2260
Total cost.....	497,720	92.01	250,491	82.41	329,077	86.51	377,739	86.52	563,173	92.20	722,785	88.73	7,730,379	88.39
Earth excavation.....	40,618	7.99	53,438	17.59	31,166	13.46	58,806	13.48	121,990	17.80	91,807	11.27	733,029	11.61

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EXHIBIT B.—DETAIL COST PER UNIT OF WORK BY MONTHS—FISCAL YEAR 1913—Continued.

TABLE 2.—Dredging excavation—Continued.

PACIFIC DIVISION.

Items.	July.		August.		September.		October.		November.		December.	
	Quantities.	Unit cost.	Quantities.	Unit cost.	Quantities.	Unit cost.	Quantities.	Unit cost.	Quantities.	Unit cost.	Quantities.	Unit cost.
<b>PRISM.</b>	<i>Cubic yards.</i>		<i>Cubic yards.</i>		<i>Cubic yards.</i>		<i>Cubic yards.</i>		<i>Cubic yards.</i>		<i>Cubic yards.</i>	
Clearing.....	198,372	\$0.0506	189,200	\$0.0526	134,130	\$0.0611	188,414	\$0.0468	174,779	\$0.0565	349,747	\$0.0013
Operation, seagoing suction dredge.....	198,372	.0059	189,200	.0066	134,130	.0342	188,414	.0020	174,779	.0025	158,465	.0542
Repairs, seagoing suction dredge.....	16,772	.1366	54,786	.0748	88,367	.0769	51,115	.1166	84,728	.0973	158,465	.0011
Operation, small ladder dredges.....	16,772	.0458	54,786	.0720	88,367	.1244	51,115	.1797	84,728	.0619	68,304	.1277
Repairs, small ladder dredges.....	73,817	.0971	105,477	.0917	105,000	.0957	87,609	.0898	156,946	.0605	112,300	.0936
Operation, 5-yard ladder dredge.....	73,817	.0951	105,477	.0248	105,000	.0428	87,609	.0882	156,946	.0210	112,200	.0750
Repairs, 5-yard ladder dredge.....	18,550	.1581	17,150	.1951	10,225	.2579	19,625	.2190	32,520	.1205	10,778	.1389
Operation, dipper dredges.....	18,550	.0501	17,150	.0627	10,225	.0558	19,625	.0942	32,520	.1104	10,778	.0683
Repairs, dipper dredges.....	74,702		74,863		62,145	.0608	73,901	.0381				
Dikes.....	109,139	.0701	177,413	.0456	203,592	.0709	158,349	.0918	274,194	.6600	191,282	.0948
Operation, tugs, claps, and scows.....	109,139	.0243	177,413	.0282	203,592	.0347	158,349	.0949	274,194	.0288	191,282	.0227
Repairs, tugs, claps, and scows.....	74,702		74,863		62,145	.2370	73,901	.1221	101,626	.0976	98,985	.1341
Blasting.....	74,702		74,863		62,145	.1756	73,901	.1785	101,626	.1440	98,985	.1369
Operation, drill barges.....	74,702	.1163	74,863	.1654	62,145	.1575	73,901	.1047	101,626	.0897	98,985	.0813
Repairs, drill barges.....	74,702	.0203	74,863	.0057	62,145	.0052	73,901	.0131	101,626	.0066	98,985	.0033
Operation, rock breakers.....	74,702	.0165	74,863	.0155	62,145	.0226	73,901	.0161	101,626	.0130	98,985	.0140
Repairs, rock breakers.....	74,702	.0098	74,863	.0014	62,145	.0009	73,901	.0497	101,626	.0006	98,985	.0021
Small boats.....	307,511	.0048	366,613	.0035	337,722	.0067	346,763	.0074	448,973	.0042	349,747	.646
Repairs, miscellaneous equipment.....	307,511	.0037	366,613	.0049	337,722	.0180	346,763	.0214	448,973	.0179	349,747	.0130
Plant arbitrary.....	307,511	.0246	366,613	.0070	337,722	.0076	346,763	.0074	448,973	.0057	349,747	.0074
Division expense.....	307,511	.0062	366,613	.0045	337,722	.0096	346,763	.0133	448,973	.0090	349,747	.0076
Total division cost.....	307,511	.2176	366,613	.1920	337,722	.3700	346,763	.3789	448,973	.2577	349,747	.3163
Administrative and general expense.....	307,511	.0162	366,613	.0155	337,722	.0355	346,763	.0257	448,973	.0288	349,747	.0349
Total cost.....	307,511	.2338	366,613	.2075	337,722	.4055	346,763	.4046	448,973	.2865	349,747	.3512
Earth excavation..... per cent.....	232,809	75.71	291,750	79.58	275,577	81.60	272,862	78.69	347,347	77.36	250,762	71.70
Rock excavation..... do.....	74,702	24.29	74,863	20.42	62,145	18.40	73,901	21.31	101,626	22.64	98,985	28.30

Items.	January.		February.		March.		April.		May.		June.		Total.	
	Quantities.	Unit cost.	Quantities.	Unit cost.	Quantities.	Unit cost.	Quantities.	Unit cost.	Quantities.	Unit cost.	Quantities.	Unit cost.	Quantities.	Unit cost.
<b>PRISM.</b>	<i>Cubic yards.</i>		<i>Cubic yards.</i>		<i>Cubic yards.</i>		<i>Cubic yards.</i>		<i>Cubic yards.</i>		<i>Cubic yards.</i>		<i>Cubic yards.</i>	
Clearing.....	215,025	\$0.0006	239,032	\$0.0010	379,845				167,111	\$0.0549	138,316	\$0.0679	4,321,956	\$0.0001
Operation, seagoing suction dredge.....					176,054	\$0.0484	160,352	\$0.0554	167,111	.0068	138,316	.0166	1,685,193	.0571
Repairs, seagoing suction dredge.....					176,054	.0229	160,352	.0163	167,111	.0014	138,316	.0051	1,685,193	.0410
Operation, small ladder dredges.....	98,357	.0948	79,606	.1128	69,967	.1113	77,637	.1140	71,192	.0642	192,211	.0551	953,042	.0932
Repairs, small ladder dredges.....	98,357	.0516	79,606	.0308	69,967	.1180	77,637	.0586	71,192	.0642	192,211	.0128	953,042	.0670
Operation, 5-yard ladder dredge.....	94,660	.1017	133,561	.0690	124,674	.0827	108,403	.0893	79,853	.1167	148,314	.0559	1,330,514	.0820
Repairs, 5-yard ladder dredge.....	94,660	.0840	133,561	.0246	124,674	.0414	108,403	.0942	79,853	.0853	148,314	.0793	1,330,514	.0566
Operation, dipper dredges.....	22,008	.1743	25,865	.1259	9,150	.1795	10,550	.3454	25,531	.1474	26,029	.1207	227,981	.1663
Repairs, dipper dredges.....	22,008	.1942	25,865	.0543	9,150	.7795	10,550	.5425	25,531	.1812	26,029	.0910	227,981	.1504
Operation, pipe-line dredges.....									26,016	.0316	99,210	.0544	125,226	.0497
Repairs, pipe-line dredges.....									26,016	.0090	99,210	.0372	125,226	.0314
Pipe lines.....									26,016	.0016	99,210	.0032	125,226	.0029
Operation, tugs, claps, and scows.....	215,025	.0894	239,032	.0795	203,791	.0755	196,590	.0855	176,576	.0835	366,554	.0564	2,511,537	.0744
Repairs, tugs, claps, and scows.....	215,025	.0175	239,032	.0156	203,791	.0280	196,590	.0372	176,576	.0607	366,554	.0384	2,511,537	.0348
Drilling.....	92,275	.1830	81,256	.1000	82,487	.0884	72,619	.1150	53,609	.0798	179,461	1.0072	1,047,929	.0864
Blasting.....	92,275	.2272	81,256	.1331	82,487	.1339	72,619	.2630	53,609	.2767	179,461	1.1257	1,047,929	.1016
Operation, drill barges.....	92,275	.1159	81,256	.0745	82,487	.1258	72,619	.1950	53,609	.0326	179,461	.0498	1,047,929	.1130
Repairs, drill barges.....	92,275	.0107	81,256	.0417	82,487	.0140	72,619	.0077	53,609	.0089	179,461	0.79	1,047,929	.0157
Operation, rock breakers.....	92,275	.0861	81,256	.0142	82,487	.0100	72,619	.0264	53,609	.0279	179,461	.0015	1,047,929	.0072
Repairs, rock breakers.....	92,275	.0215	81,256	.0088	82,487	.0160	72,619	.0014	53,609	.0018	179,461	.0039	4,321,956	.0055
Small boats.....	215,025	.0056	239,032	.0073	379,845	.0079	356,942	.0073	369,703	.0052	604,080	.0070	4,321,956	.0891
Repairs, miscellaneous equipment.....	215,025	.0104	239,032	.0063	379,845	.0198	356,942	.0171	369,703	.0145	604,080	.0159	4,321,956	.0136
Plant arbitrary.....	215,025	.0120	239,032	.0298	379,845	.0168	356,942	.0172	369,703	.0177	604,080	.0177	4,321,956	.0096
Division expense.....	215,025	.0091	239,032	.0148	379,845	.0112	356,942	.0111	369,703	.0121	604,080	.0087	4,321,956	
Total division cost.....	215,025	.7039	239,032	.5450	379,845	.3344	356,942	.3958	369,703	.3384	604,080	.1725	4,321,956	.3238
Administrative and general expense.....	215,025	.0585	239,032	.0565	379,845	.0231	356,942	.0337	369,703	.0383	604,080	.0228	4,321,956	.0304
Total cost.....	215,025	.7624	239,032	.6024	379,845	.3575	356,942	.4295	369,703	.3767	604,080	.1953	4,321,956	.3542
Earth excavation..... per cent.....	122,750	57.09	157,776	66.01	297,358	78.28	284,323	79.66	316,094	85.50	424,619	70.29	3,274,027	75.75
Rock excavation..... do.....	92,275	42.91	81,256	33.99	82,487	21.72	72,619	20.34	53,609	14.50	179,461	29.71	1,047,929	24.25



EXHIBIT B.—DETAIL COST PER UNIT OF WORK BY MONTHS—FISCAL YEAR 1913—Continued.  
TABLE 3.—*Hydraulic excavation.*  
CENTRAL DIVISION.

Items.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	Total.
<b>Quantities.</b>													
PRISM. . . . . cubic yards.												57, 274	57, 274
Blasting . . . . .												\$0. 0001	\$0. 0001
Pumping station . . . . .												. 0287	. 0287
Pipe lines and monitors . . . . .												. 0286	. 0286
Fumes . . . . .												. 0093	. 0093
Maintenance of equipment . . . . .												. 0129	. 0129
Plant arbitrary . . . . .												. 1000	. 1000
Division expense . . . . .												. 0039	. 0039
Total division cost . . . . .												. 1835	. 1835
Administrative and general expenses . . . . .													
Total cost . . . . .												. 1835	. 1835

## PACIFIC DIVISION.

Items.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	Total.
<b>Quantities.</b>													
PRISM. . . . . cubic yards.	85, 000	75, 031	117, 337	88, 963	85, 300								451, 631
Clearing . . . . .													
Drilling . . . . .													
Blasting . . . . .					<b>\$0. 0002</b>								
Pumping station . . . . .	\$0. 0620	\$0. 0800	\$0. 0387	\$0. 0599	. 0504								\$0. 0563
Pipe lines and monitors . . . . .	. 0963	. 0233	. 0136	. 0450	. 0207								. 0383
Dredging pumps . . . . .	. 0417	. 0439	. 0206	. 0287	. 0216								. 0302
Relay pumps . . . . .													
Dikes . . . . .	. 0260	. 0126	. 0107	. 0120	. 0102								. 0140
Maintenance of equipment . . . . .	. 0702	. 1201	. 0384	. 0572	. 0242								. 0390
Power . . . . .	. 0811	. 1063	. 0668	. 1067	. 0948								. 0892
Plant arbitrary . . . . .	. 7161	. 7146	. 7129	. 7147	. 7142								. 7144
Division expense . . . . .	. 0135	. 0122	. 0057	. 0124	. 0075								. 0099
Total division cost . . . . .	1. 1069	1. 1130	. 9074	1. 0366	. 9434								1. 0113
Administrative and general expenses . . . . .	. 0254	. 0248	. 0128	. 0108	. 0146								. 0171
Total cost . . . . .	1. 1323	1. 1378	. 9202	1. 0474	. 9580								1. 0284

1 Bold-face type indicates credit.

## EXHIBIT B.—DETAIL COST PER UNIT OF WORK BY MONTHS—FISCAL YEAR 1913—Continued.

TABLE 4.—*Masonry.*  
ATLANTIC DIVISION.

Items.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	Total.
<b>GATUN SPILLWAY.</b>													
Concrete.....cubic yards...	1,357	1,111	976	1,303	855	3,017	3,817	3,028	2,659	1,358	717	455	20,653
Cement.....	\$1.5298	\$1.5972	\$1.5523	\$1.4435	\$1.6194	\$1.4637	\$1.3371	\$1.2863	\$1.4397	\$1.5031	\$1.6607	\$1.8352	\$1.4225
Stone.....	1.9703	1.9998	1.9937	1.8037	2.0035	1.8235	1.0825	.9602	.9955	1.0484	1.1116	.7451	1.3893
Sand.....	.5925	.5822	.5914	.5976	.5965	.5900	.4741	.3639	.3081	.2984	.3490	.4027	.5013
Mixing.....	.7380	1.0765	.7469	1.1308	.9704	.4603	.2400	.3354	.3283	.4387	.5382	.8872	.5288
Wood forms.....	1.9796	2.0555	2.6318	1.2802	1.4662	1.8273	2.3332	1.3645	1.4652	2.5117	2.4000	4.0819	1.7635
Placing.....	1.4473	1.3319	1.7725	.8098	2.0311	.8536	.7326	.9761	.9761	.9202	2.5154	1.3711	1.1133
Reinforcements.....	.1086	.0849	.0849	.0849	.0849	.0849	.0849	.1152	.0017	.2292	.0058	.0017	.0026
Pumps.....	.0016	.0046	.0222	.....	.....	.....	.....	.....	.0101	.....	.....	.....	.0027
Cofferdams.....	.....	.....	.....	.....	1.3039	.....	.....	.0157	.....	.0994	.5002	1.7531	.0022
Maintenance of equipment.....	1.0706	.6983	.6822	.2388	.2724	.2184	.1798	.3451	.2890	.3616	.2066	.0263	.3514
Plant arbitrary.....	.5340	.5340	.5340	.5340	.5340	.5340	.2540	.2540	.2540	.2540	.2540	.2540	.3708
Division expense.....	.4124	.3686	.4577	.3244	.2002	.1812	.1511	.1417	.1234	.3194	.4739	.8236	.2440
Total division cost.....	10.3852	10.2046	11.4645	7.8289	9.3838	7.9275	5.7370	6.7091	6.3011	7.9841	10.3814	12.1802	7.8224
Administrative and general expense.....	1.0300	1.3218	1.2055	.8897	.8983	.6566	.4505	.5179	.5875	2.0498	1.6662	2.3853	.8637
Total cost.....	11.4152	11.5264	12.6700	8.6986	10.2821	8.5841	6.1875	7.2270	6.8886	10.0339	12.0476	14.5655	8.6861
<b>Masonry, reinforced.....cubic yards.</b>													
Cement.....	.....	112	112	314	.....	49	369	.....	.....	.....	.....	110	1,066
Stone.....	.....	\$2.2500	\$1.5536	\$1.4414	.....	\$1.4676	\$1.3381	.....	.....	.....	.....	\$1.8497	\$1.5436
Sand.....	.....	2.0003	2.0089	1.8020	.....	1.8280	1.0906	.....	.....	.....	.....	.7322	1.4004
Mixing.....	.....	.5383	.5937	.5906	.....	.5484	.4716	.....	.....	.....	.....	.2925	.5138
Wood forms.....	.....	1.0570	.6969	.7538	.....	.6933	.3826	.....	.....	.....	.....	.8965	.6375
Placing.....	.....	5.4806	1.4729	.0475	.....	37.1786	3.1144	.....	.....	.....	.....	2.2141	4.0896
Reinforcements.....	.....	1.3323	1.7439	.4338	.....	1.8667	.9829	.....	.....	.....	.....	1.3549	.9323
Maintenance of equipment.....	.....	16.6386	2.5053	.2012	.....	32.0068	.....	.....	.....	.....	.....	.....	3.5419
Plant arbitrary.....	.....	.6985	.6819	.2414	.....	.2302	.2364	.....	.....	.....	.....	.0266	.3113
Division expense.....	.....	.5340	.5340	.5340	.....	.5340	.2540	.....	.....	.....	.....	.2568	.2568
Total cost.....	.....	.5650	.4710	.1684	.....	2.4493	.2990	.....	.....	.....	.....	.4963	.4415
Total division cost.....	.....	31.0946	12.2611	6.2231	.....	78.2049	8.1696	.....	.....	.....	.....	8.1396	13.9401
Administrative and general expense.....	.....	4.2853	1.3574	.3168	.....	16.0018	.8804	.....	.....	.....	.....	1.3724	1.9076
Total cost.....	.....	35.3799	13.6185	6.5399	.....	94.2067	9.0500	.....	.....	.....	.....	9.5120	15.8477
Total masonry.....cubic yards.....	1,357	1,223	1,088	1,617	855	3,066	4,186	3,028	2,659	1,358	717	565	21,719
Total cost.....	\$11.4152	\$13.7108	\$12.7676	\$8.2794	\$10.2821	\$9.9525	\$6.4399	\$7.2270	\$6.8886	\$10.0339	\$12.0476	\$13.5615	\$9.0377



GATUN LOCKS.											
Concrete.....cubic yards.											
3,735	3,222	1,926	2,685	5,114	4,043	28,689	30,680	33,424	18,501	5,634	96
\$2,1120	\$1,9304	\$1,5537	\$1,3733	\$1,3265	\$1,3884	\$1,2807	\$1,3192	\$1,2612	\$1,2437	\$1,2160	\$1,0532
1,7641	1,8648	1,5759	1,2810	1,5921	1,8371	1,9956	2,0328	1,4369	1,6802	1,5301	1,7406
6832	6920	6947	5985	5781	6308	6110	6205	3770	3011	2756	2850
3696	3327	6469	8430	6144	6768	6248	1707	1594	2608	3301	3857
5499	9035	1,2632	1,6778	2,5876	1,8776	5527	6487	6386	9911	1,3349	9,0955
1,1542	5398	2,4249	1,6737	1,0257	1,2654	3594	3595	1,0016	7077	1,0722	1,0046
Reinforcements.							3004	8201	6035	2381	13,8180
Pumps.							0017	0017	0017	0035	5847
Power.							0460	0460	0623	1087	0075
Maintenance of equipment.							0477	0458	0364	0996	0814
Plant arbitrary.							1629	1641	3025	1,741	1,4145
Division expense.							9380	9380	9380	3263	2,144
2,104	3,405	4,126	5,529	3,971	2,196	0796	0700	0616	1818	3263	2,5654
Total division cost.							6,4087	5,5300	5,8508	6,661	6,5383
Administrative and general expense.							2072	2640	3244	7734	4,406
8,474	7,949	10,485	9,976	9,869	9,5580	6,2473	6,6159	5,7940	6,1752	7,4395	26,5812
8,5222	8,8128	11,6435	11,9269	11,0270	10,4090	6,5109	6,6159	5,7940	6,1752	7,4395	26,5812
4,358	4,164	1,236	507	915	1,049	101	.....	1,504	2,672	6,552	4,982
Masonry, reinforced.....cubic yards.							.....	.....	.....	.....	.....
Cement.							.....	.....	.....	.....	.....
Stone.							.....	.....	.....	.....	.....
Sand.							.....	.....	.....	.....	.....
Mixing.							.....	.....	.....	.....	.....
Wood forms.							.....	.....	.....	.....	.....
Steel forms.							.....	.....	.....	.....	.....
Power.							.....	.....	.....	.....	.....
Placing.							.....	.....	.....	.....	.....
Reinforcements.							.....	.....	.....	.....	.....
Chipping to grade.							.....	.....	.....	.....	.....
Pumps.							.....	.....	.....	.....	.....
Maintenance of equipment.							.....	.....	.....	.....	.....
Plant arbitrary.							.....	.....	.....	.....	.....
Division expense.							.....	.....	.....	.....	.....
11,8899	10,6451	12,6498	21,1631	12,5093	13,8836	56,2301	.....	10,1132	12,4719	9,1833	10,8290
9,991	1,0727	1,4407	3,3904	1,2886	2,1579	5,6483	.....	1,0669	1,4639	8,8442	1,1884
12,8790	11,7178	14,0905	24,5535	13,7949	16,0415	61,8874	.....	11,1801	13,9538	10,0275	12,0114
Total masonry.....cubic yards.							.....	.....	.....	.....	.....
8,093	7,386	3,162	3,252	6,029	5,092	28,790	30,680	34,928	21,173	12,186	165,849
Total cost.							\$6,6159	\$6,0259	\$7,2018	\$8,8310	\$8,7367
\$10,8083	\$10,4505	\$12,6001	\$14,1284	\$11,4471	\$11,5694	\$6,7111	.....	.....	.....	.....	.....

1 Bold-face type indicates credit.

## EXHIBIT B.—DETAIL COST PER UNIT OF WORK BY MONTHS—FISCAL YEAR 1913—Continued.

TABLE 4.—Masonry—Continued.

## ATLANTIC DIVISION—Continued.

Items.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	Total.
PERMANENT POWER HOUSE—GATUN.													
Masonry substructure.....cubic yards..	196			12	348	93	163	351	626	941	882	1,456	5,068
Cement.....	\$1.5306			\$1.4100	\$1.0207	\$1.4554	\$1.3343	\$1.2856	\$1.4597	\$1.5024	\$1.6080	\$1.8329	\$1.0086
Stone.....	1.9682			1.8567	2.0011	1.8209	1.0894	.9552	.9946	1.0479	1.1098	.7438	1.0770
Sand.....	.5918			.5600	.5955	.5490	1.4762	.5947	.3677	.2982	.3492	.2863	.3755
Forms.....	.0958			.62.0700	2.3135	3.6750	.3721	.3630	2.4125	1.4645	3.1647	2.0076	2.1575
Mixing.....	.7379			.7517	.9705	2.9807	.3845	.4648	.6931	.1731	.7261	.9114	.7023
Reinforcement.....					.0857		.0134			.0033	.0354	.1454	.0549
Placing.....	1.2774			3.9276	2.6277	4.6925	1.2332	1.1195	1.3876	1.8155	2.0070	1.3059	1.7345
Cofferdams.....					.4616	.4118	1737	.3552	.4962	.4375	.2455	.0302	.0448
Maintenance of equipment.....	1.0639			.2400	.3002	.2251	.2367	.2540	.2540	.2540	.2540	.2540	.2898
Plant arbitrary.....	.5340			.5340	.5340	.5340	.2540	.1221	.1238	.1772	.2323	.1773	.2301
Division expense.....	.2578			2.4358	.5311	.7738	.2579						
Total division cost.....	8.0874			73.7858	12.0416	17.1036	6.8254	5.5441	8.1892	7.1736	9.7920	7.6948	8.5739
Administrative and general expenses.....	.2754			1.6683	.8987	1.8065	.3629	.2409	.9681	.4489	.5837	.2603	.4724
Total cost.....	8.3628			75.1175	12.9403	18.9101	7.1883	5.7850	8.7573	7.6225	10.3757	7.9611	9.0463

## PACIFIC DIVISION.

PEDRO MIGUEL DAM.													
Masonry.....cubic yards..	479	418		40			630						1,567
Concrete.....	\$3.1524	\$3.7372		\$11.1518			\$3.8515						\$4.2484
Plant arbitrary.....		1.5021		.7000			.3911						.5758
Maintenance of equipment.....		.1823		.1170			.0650						.0777
Division expense.....	.0767	.0890		.7865			.0655						.1221
Total division cost.....	3.2291	5.5106		12.7553			4.3731						5.0240
Administrative and general expenses.....	.1537	.2352		.9817			.3287						.3632
Total cost.....	3.3828	5.7458		13.7370			4.7018						5.3872

PEDRO MIGUEL LOCKS.

Concrete.....cubic yards..										
6, 142	3, 911	2, 384	6, 362	7, 541	5, 508	4, 950	2, 362	123	62	106
\$1.6280	\$1.7361	\$0.5171	\$3.4052	\$1.4754	\$1.1491	\$1.5454	\$1.7475	\$1.3438	\$1.5819	\$2.1671
.7347	.7103	.8091	.7533	.7440	.6976	.5567	.5573	.6170	.5777	.7063
.3243	.3149	.3194	.4600	.4449	.4050	.3512	.3550	.3900	.3900	.3850
Mixing.....	.4711	.1.4618	.9907	.8332	.8040	.1.3123	.1.4268	.8634	.5.9007	14.0614
Placing.....	.9614	.1.1600	.8264	.6576	.6999	.7854	.6.2764	44.6226	64.4215	9.7055
Wood forms.....	.6885	.7368	.8896	.3774	.5488	.3976	.14.4731	9.0903	41.8003	201.3207
Pumps.....	.0341	.0198	.0579	.0529	.1484	.0098	.0283	.0139	.0158	.0793
Power.....	.0076	.0095	.0005	.0001	.0001	.0005	.0234	.0234	.0022	.0022
Maintenance and equipment.....	.1932	.2592	.0998	.0644	.1310	.0482	.1317	.5965	.1.0773	1.5657
Plant arbitrary.....	.7000	.7000	.7000	.7000	.7000	.1.0498	.1.607	.1.2853	.2.5903	18.7529
Division expense.....	.1538	.1998	.1553	.1669	.1266	.1384	.1607	.2.5376	.2.5376	.1.803
Total division cost.....	5.8967	6.7865	7.8230	5.5692	5.4705	4.8494	5.8500	25.8404	39.3142	302.3207
Administrative and general expense.....	.4070	.6073	1.1986	.5131	.5297	.4308	.7949	11.3641	7.2069	65.0100
Total cost.....	6.3037	7.3938	7.1006	6.0793	6.0002	5.2802	6.6449	37.2045	46.5211	101.6909
Masonry, reinforced.....cubic yards..										
5, 340	2, 103	669	240	124	274	1, 210	1, 935	4, 678	1, 597	488
\$2.3029	\$2.3870	\$0.4016	\$3.7201	\$1.9865	\$0.7227	\$2.1936	\$2.3800	\$1.6935	\$2.1770	\$2.8674
.7039	.6788	.7582	.6953	.6645	.6734	.5850	.4044	.5875	.7179	.9892
Sand.....	.3032	.2963	.5060	.5108	.4464	.3857	.3633	.3669	.3902	.4215
Mixing.....	.5512	.6420	1.5267	3.6634	1.7193	1.9997	1.5640	.7769	.8793	3.1815
Wood forms.....	1.3742	1.0134	1.9078	2.3453	2.5465	2.5596	1.6943	1.3024	1.8381	7.0299
Steel forms.....	.0017	.0017	.0017	.0017	.0017	.0017	.0017	.0018	.0035	.0125
Power.....	.8449	1.7149	4.4756	12.6267	10.7723	2.0530	1.2737	.7672	3.8958	7.7697
Reinforcements.....	1.2214	.5124	.5649	1.8706	10.8020	2.7440	1.9734	.7691	2.3366	1.2540
Pumps.....	.0346	.0196	.0491	.0542	.0491	.0189	.0283	.0140	.0503	.8272
Maintenance of equipment.....	.0934	.2270	.2283	1.0410	.0571	.1060	.0919	.1039	.0671	1.9545
Plant arbitrary.....	.6997	.6937	.6854	.6563	.6492	.0488	.0919	.1039	.0671	.0503
Division expense.....	.2772	.3016	.5243	1.3724	1.2866	.0091	.2725	.1923	.3541	1.0304
Total division cost.....	8.4103	8.4867	12.0217	25.6098	23.8614	12.5806	10.0458	6.5755	10.0337	17.6014
Administrative and general expense.....	.6916	.8890	1.5217	1.3359	3.0906	1.3246	.6883	.4283	2.3662	4.9915
Total cost.....	9.1019	9.3797	13.5434	26.9457	26.9520	13.9052	10.7341	7.0038	12.3999	22.5929
Total masonry.....cubic yards..	11, 482	6, 014	3, 053	6, 602	7, 605	6, 160	4, 297	4, 801	1, 659	594
Total cost.....	\$7.6051	\$8.0882	\$8.5592	\$8.3296	\$6.4169	\$6.9744	\$8.4863	\$7.7775	\$13.6751	\$36.7080
Total cost.....										
39,465										
\$1.7599										
.7063										
.3850										
.9705										
.7822										
.0574										
.0022										
1.2556										
.5587										
.1803										
6.5432										
.4842										
7.0274										
367.3307										
18,902										
244										
\$2.1045										
.0449										
.3478										
.9352										
1.5837										
.0018										
1.6334										
.0366										
.1174										
.3217										
.3446										
9.7389										
1.1002										
10.8991										
58,367										
\$8.2813										

1 Bold-face type indicates credit.

EXHIBIT B.—DETAIL COST PER UNIT OF WORK BY MONTHS—FISCAL YEAR 1913—Continued.  
TABLE 4.—Masonry—Continued.

## PACIFIC DIVISION—Continued.

Items.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	Total.
<b>Concrete.....cubic yards.</b>	60,827	68,154	41,178	49,003	34,784	42,763	45,501	31,692	15,742	9,350	3,447	100	402,607
Cement.....	\$1.8356	\$1.9540	\$1.6779	\$1.9738	\$1.9308	\$1.5807	\$1.9279	\$1.9789	\$1.5795	\$2.2196	\$1.8937	\$1.7212	\$1.5586
Stone.....	7335	7161	8091	7334	7435	6975	6045	5558	5760	7357	1.0391	8032	7081
Sand.....	3238	3149	3106	4601	4450	4050	3800	3550	3650	3842	4.251	3900	3703
Mixing.....	2631	2395	3177	3169	3082	2923	1967	1795	2237	2302	2802	5.2423	2559
Wood form.....	4180	3740	6348	5463	4805	4716	3694	5295	9.009	0.172	2.3496	70.9228	5327
Steel forms.....	0207	0163	0131	0008	0002	0229	0317	0307	0430	0067	0.164	0.126	0.178
Placing.....	3357	2713	4230	4632	4336	3524	3695	4578	6863	6207	1.5414	35.0708	4186
Pumps.....	0374	0312	0687	0329	0362	0249	0196	0128	0949	0271	0.0316	0.034	0.031
Power.....	0311	0275	0373	0329	0476	1458	0371	0865	0470	0585	0.0642	10.09	0376
Maintenance of equipment.....	1424	1275	2032	1586	2078	0413	1405	1642	2377	0627	1920	9.8721	1604
Plant arbitrary.....	5490	5407	5408	5407	5406	5405	5304	5305	5300	5300	5126	5300	5377
Division expense.....	0607	0695	0641	1315	1195	0721	0644	0747	1258	1473	2522	10.0659	0945
Total division cost.....	4.8200	4.0815	5.1293	5.4131	5.2942	4.6070	4.6717	4.9799	5.3307	8.9399	8.5981	135.4452	5.0273
Administrative and general expense.....	2671	2696	3796	2613	4171	3522	2826	3958	7499	8915	1.8614	39.0945	3696
Total cost.....	5.0871	4.9511	5.5089	5.6744	5.7113	4.9592	4.9543	5.3757	6.0806	6.8314	10.4595	175.1397	5.3969
<b>Masonry, reinforced.....cubic yards.</b>	5,171	7,229	4,962	5,807	5,102	4,986	4,973	3,292	3,530	1,930	612	591	48,185
Cement.....	\$2.2153	\$2.4103	\$2.2594	\$2.0519	\$1.9786	\$2.0921	\$2.1477	\$2.6633	\$2.0413	\$2.7403	\$2.5987	\$2.3743	\$2.2303
Stone.....	7043	6829	7715	7223	7120	6680	5788	5609	5876	7175	9864	7989	6812
Sand.....	3058	2954	3002	4630	4481	4084	3819	3615	3681	3904	4222	3894	3705
Mixing.....	9471	8181	1.1932	8156	7321	5735	5984	4929	4959	7581	5552	7684	7610
Wood forms.....	4.7559	3.0980	3.2516	2.9329	2.9472	2.9038	3.5060	3.3784	2.1742	1.4341	1.2609	1.5106	3.1200
Steel forms.....	0138	0012	0152	0148	0214	1.0031	0223	0406	0219	0205	0114	0191	0010
Power.....	0185	1.0622	1.2288	1.1354	0816	0165	0623	0406	0287	0295	0114	0191	0157
Placing.....	1.2700	1.2700	1.2700	1.2700	1.2700	1.2700	1.2700	1.2700	1.2700	1.2700	1.2700	1.2700	1.2700
Reinforcements.....	2.1978	1.6281	2.0431	1.4707	1.3135	1.2016	1.5801	0.7989	0.882	0.932	0.806	0.806	1.2602
Pumps.....	0371	0311	0679	0329	0361	0248	0197	0128	0049	0269	0317	0464	0334
Maintenance of equipment.....	3218	0903	0442	1332	1117	0915	0640	103	1103	0936	0398	1554	1611
Plant arbitrary.....	5898	5386	5386	5386	5386	5386	5251	5251	5286	5251	5251	5251	5251
Division expense.....	5852	3648	3705	5028	4292	2087	3141	3228	2784	3615	4068	5837	3919
Total division cost.....	13.9324	11.0297	12.1741	10.8350	10.5505	9.7449	9.7435	10.8633	7.9881	9.4067	10.8907	9.0898	10.8023

Administrative and general expense...	1.1644	.9136	1.1530	.9237	1.0831	1.0065	.7141	.0884	.8881	1.6569	3.6885	1.6638	1.0576
Total cost.....	15.0968	11.9433	13.3271	11.7587	11.6336	10.7514	10.4626	11.9517	8.8762	11.0636	14.5792	11.3536	11.8599
Total masonry.....cubic yards..	66,028	75,413	46,140	54,810	39,886	47,749	50,474	34,984	19,272	11,280	4,059	697	450,792
Total cost.....	\$5.8710	\$5.6213	\$6.3497	\$6.3191	\$6.4689	\$5.5640	\$5.4970	\$5.9945	\$6.5926	\$7.5555	\$11.0807	\$36.2622	\$6.0877
MIRAFLORES WEST DAM.													
Masonry.....	150					440	2,628	755	430				4,403
Concrete.....													
Plant arbitrary.....	\$3.6637					\$2.4887	\$3.8709	\$3.8137	\$3.3500				\$3.6650
Maintenance of equipment.....						.5300	.5300	.5300	.5300				.5313
Division expense.....	.0196					.1096	.0747	.0623	.0425				.0755
Total division cost.....	3.6833					3.2205	4.5380	4.4911	3.9793				4.3330
Administrative and general expense.....	.1940					.1511	.2524	.9029	.5187				.4107
Total cost.....	3.8773					3.3716	4.7904	5.3940	4.4980				4.7437
MIRAFLORES SPILLWAY.													
Masonry, spillway, plain.....cubic yards..							1,077	3,653	12,432	6,222	18,607	21,716	63,707
Cement.....													
Stone.....							\$1.9310	\$1.9923	\$1.5587	\$2.2247	\$2.1501	\$1.6804	\$1.8691
Sand.....							.6053	.5558	.6138	.7532	1.0416	.7998	.8140
Mixing.....							.8904	.3551	.3650	.3900	.4250	.3900	.3632
Wood forms.....							8242	8002	4737	8224	4088	3968	4907
Placing.....							2,3644	8098	3127	1,3068	4160	4914	5641
Reinforcement.....							.5072	1.2374	.7746	1.3269	.5929	.5175	.7098
Power.....								.0371	.0062	.0400	.0043	.0031	.0107
Pumping.....							.0052	.0010	.0199	.0403	.0320	.0114	.0213
Maintenance of equipment.....									.0049	.1543	.0690	.0785	.0629
Plant arbitrary.....							1,287	1,208	1,325	2,513	1,282	1,643	1,1530
Division expense.....							.5301	.5300	.5300	.5300	.5300	.5300	.5300
Total division expense.....							.2018	1,409	.0969	.2572	.1150	.1400	.1368
Administrative and general expense.....							7,4813	6,6704	4,8919	8,1031	5,9129	5,2032	5,7556
Total cost.....							.4724	.1536	.8580	.8937	.2660	.5534	.3937
Total cost.....							7,9537	6,8240	5,0294	8,9911	6,1789	5,7566	6,1493

1 Bold-face type indicates credit.

## EXHIBIT B.—DETAIL COST PER UNIT OF WORK BY MONTHS—FISCAL YEAR 1913—Continued.

TABLE 4.—Masonry—Continued.

## PACIFIC DIVISION—Continued.

Items.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	Total.
MIRAFLORES SPILLWAY.													
Masonry, spillway, reinforced, cubic yards.....										62	130	243	435
Cement.....										\$2.7431	\$2.9539	\$2.3343	\$2.5746
Stone.....										.7185	.9994	.7998	.8469
Sand.....										.3900	.4250	.3916	.4009
Mixing.....										.1989	.1001	.1594	.1050
Placing.....										.3642	1.5259	.2507	.6506
Wood forms.....										3.8144	8.3006	6.1589	6.4569
Reinforcements.....										16.5692	12.5738	1.3972	6.8914
Pumping.....										.0250	.0319	.0465	.0391
Maintenance of equipment.....										.9235	.1335	.0656	.2079
Plant arbitrary.....										.5300	.5300	.5300	.5294
Power.....										.0571	.0612	.0243	.0400
Division expense.....										.6708	.9538	.7476	.7973
Total division cost.....										27.0047	28.6491	12.9119	19.6000
Administrative and general expense.....											1.3683	1.8151	1.4214
Total cost.....										27.0047	30.0184	14.7270	21.0214
Total masonry, spillway, cubic yards.....							1,077	3,653	12,432	6,284	18,737	21,959	64,142
Total cost.....							\$7.9537	\$6.8240	\$5.0294	\$9.1391	\$6.3443	\$5.8559	\$6.2504

TABLE 5.—Dry filling.

## ATLANTIC DIVISION.

Items.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	Total.
<b>GATUN DAM.</b>													
Dry fill.....cubic yards..	207,405	201,029	184,300	258,999	184,485	142,245	149,609	88,792	96,101	106,862	93,449	99,457	1,812,733
Excavation.....	\$0.0678	\$0.0625	\$0.0757	\$0.1171	\$0.0763	\$0.0771	\$0.0329	\$0.1049	\$0.1097	\$0.0786	\$0.0807	\$0.0300	\$0.0773
Tracks.....	.0886	.1197	.1122	.0698	.1045	.0855	.0210	.0805	.0791	.0374	.0668	.0648	.0802
Trestles.....	.0009	1.0010	.0030	.0003	.0001	.....	.....	.0001	.....	.0008	.....	.....	.0004
Transportation.....	.0732	.0917	.0840	.0738	.0830	.0776	1.1874	.0133	.0485	.0474	.0857	.0304	.0300
Filling.....	.0357	.0484	.1256	.0714	.1222	.1067	.0568	.0320	.0927	.0650	.0802	.0792	.0732
Maintenance of equipment.....	.0376	.0306	.0622	.0324	.0364	.0577	.0297	.0807	.0487	.0506	.0397	.0096	.0453
Division expense.....	.0212	.0247	.0232	.0318	.0326	.0268	.0139	.0151	.0121	.0086	.0169	.0124	.0227
Total division cost.....	.3270	.3766	.4949	.4186	.4651	.4314	1.0380	.3666	.3908	.2884	.3630	.2363	.3551
Administrative and general expense.....	.0239	.0298	.0469	.0305	.0456	.0419	.0293	.0475	.0259	.0128	.0209	.0148	.0311
Total cost.....	.3509	.4064	.5418	.4491	.5107	.4733	1.0127	.4141	.4167	.3012	.3839	.2511	.3862
<b>GATUN LOCKS.</b>													
Back filling.....cubic yards..	107,216	95,904	68,299	48,978	12,411	33,232	33,411	34,498	40,972	33,168	27,442	31,225	565,756
Drilling.....	\$0.0119	\$0.0239	\$0.0340	\$0.0171	\$0.0073	.....	.0002	\$0.0368	.....	.....	\$0.0345	\$0.0288	\$0.0177
Blasting.....	.0212	.0270	.0352	.0328	.0155	.0207	.....	.0217	.....	.....	.0107	.0325	.0220
Leading.....	.0342	.0435	.0463	.0239	.0113	.0478	1.0005	.0393	\$0.0015	.0004	.....	.0430	.0294
Tracks.....	.1315	.1254	.0380	.0480	.0242	1.7285	.0294	.0859	.0362	.0459	.0978	.1006	.0357
Transportation.....	.1780	.1744	.0324	.0975	.3050	.0839	1.3065	.0278	.0362	.....	.0765	.0760	.0794
Filling.....	.0459	.1025	.0814	.0757	.1133	.1039	.1296	.1468	.1242	.2783	.1294	.3379	.1229
Maintenance of equipment.....	.0329	.0316	.0327	.0467	.0257	.0609	.0014	.1077	.0041	.0092	.0742	.0386	.0430
Division expense.....	.0376	.0408	.0235	.0307	.0371	.0201	.0147	.0254	.0089	.0245	.0338	.0518	.0304
Total division cost.....	.5132	.5691	.3435	.3734	.5403	1.8862	1.1317	.5014	.1836	.3592	.5699	.7292	.3905
Administrative and general expense.....	.0448	.0570	.0553	.0340	.0674	.0343	.0219	.0553	.0221	.0347	.0411	.0646	.0451
Total cost.....	.5580	.6261	.3988	.4074	.6077	1.9519	1.1098	.5567	.2057	.3939	.6080	.7938	.4256
<b>Filling center wall.....cubic yards..</b>													
Loading.....	\$0.0729	\$0.0893	\$0.1394	.....	.....	.....	.....	.....	.....	.....	.....	.....	\$0.0931
Tracks.....	.1425	.1186	.1900	.....	.....	.....	.....	.....	.....	.....	.....	.....	.1403
Transportation.....	.2125	.2192	.2885	.....	.....	.....	.....	.....	.....	.....	.....	.....	.0860
Filling.....	.0839	.0714	.1523	.....	.....	.....	.....	.....	.....	.....	.....	.....	.0944
Maintenance of equipment.....	.1198	.0764	.1732	.....	.....	.....	.....	.....	.....	.....	.....	.....	.1096

1 Bold-face type indicates credit.

EXHIBIT B.—DETAIL COST PER UNIT OF WORK BY MONTHS—FISCAL YEAR 1913—Continued.  
TABLE 5.—*Dry filling*—Continued.  
ATLANTIC DIVISION—Continued.

Items.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	Total.
GATUN LOCKS—continued.													
Filling center wall—Continued.													
Plant arbitrary.....	\$0.2710	\$0.2710	\$0.2710										\$0.2710
Division expense.....	.0388	.0351	.0411										.0376
Total division cost.....	.9514	.8810	1.2555										.8320
Administrative and general expense.....	.0414	.0396	.0566										.0434
Total cost.....	.9928	.9206	1.3121										.8754
PACIFIC DIVISION.													
PEDRO MIGUEL DAM.													
Dry fill.....cubic yards..	16,150	12,481	13,615	16,267	18,030	11,666	20,198		2,000				114,117
Tracks.....	\$0.1783	\$0.2019	\$0.1347	\$0.0764	\$0.1091	\$0.1186	\$0.0932		\$0.1144				\$0.1226
Transportation.....	.0629	.1331	.0999	.0736	.0511	.0409	.0519		.0671				.0950
Filling.....	.0823	.1372	.0798	.0716	.0566	.0304	.0302		.0767				.1293
Maintenance of equipment.....	.0654	.0799	.0718	.0567	.0327	.0371	.0302		.0330				.0472
Plant arbitrary.....	.0267	.0246	.0146	.0164	.0156	.0116	.0096		.0300				.0005
Division expense.....									.0147				.0168
Total division cost.....	.4156	.5767	.4008	.2947	.2896	.2648	.2153		.3359				.3312
Administrative and general expense.....	.0327	.0422	.0314	.0133	.0242	.0236	.0138						.0632
Total cost.....	.4483	.6189	.4322	.3080	.3138	.2884	.2291		.3359				.3582
PEDRO MIGUEL LOCKS.													
Back filling.....cubic yards..	10,184	15,411	17,296	13,039	4,659	10,996	11,023	26,402	19,400	25,752	12,496	7,200	173,938
Tracks.....	\$0.1708	\$0.0684	\$0.0654	\$0.1349	\$0.2953	\$0.1860	\$0.1470	\$0.0906	\$0.1098	\$0.0776	\$0.0949	\$0.1624	\$0.1128
Transportation.....	.0143	.0906	.0900	.1098	.3160	.1477	.0608	.1182	.0798	.0220	.0576	.0490	.0773
Filling.....	.1504	.0454	.0655	.1231	.3235	.1605	.0874	.1010	.0884	.1402	.0932	.1342	.1112
Maintenance of equipment.....	.0202	.0436	.0517	.0696	.1572	.1039	.0429	.0366	.0393	.0101	.0239	.0160	.0427
Plant arbitrary.....	.0800	.0800	.0800	.0800	.0800	.1300	.1300	.1300	.1300	.0903	.1252	.1300	.1032
Division expense.....	.0241	.0081	.0102	.0283	.0636	.0241	.0133	.0132	.0155	.0109	.0140	.0307	.0170
Total division cost.....	.4508	.3361	.3628	.5457	1.2356	.7022	.4814	.4806	.4626	.3511	.4088	.5223	.4642



Administrative and general expense.....	.0414	.0273	.0301	.0266	.1476	.0757	.0339	.0162	.0308	.0315	.0605	.0832	.0413
Total cost.....	.5012	.3634	.3929	.5723	1.3832	.7779	.5153	.5038	.5136	.3826	.4693	.6055	.5055
Filling center wall.....cubic yards.....	3.404	9.890	597	16.897	14.597	3,420	15,448	26,416	32,000	39,318	19,950	11,275	193,212
Loading.....													
Tracks.....	\$0.0567	\$0.0689	\$0.0987	\$0.0769	\$0.1794	\$0.2638	\$0.0292	\$0.1114	\$0.0560	\$0.0006	\$0.0332	\$0.0850	\$0.0384
Transportation.....	.1717	.0676	.0730	.0744	.1187	.0198	.0012	.0002	.0001	.0515	.0948	.0607	.0667
Filling.....	.2210	.0621	.0748	.0723	.0870	.2761	.1300	.0842	.0624	.0523	.1394	.4514	.1112
Maintenance of equipment.....	.1844	.0335	.1849	.0346	.0623	.1979	.0184	.0356	.0260	.0267	.0893	.0510	.0432
Plant arbitrary.....	.0800	.0800	.0800	.0800	.0800	.0800	.1300	.1300	.1300	.1300	.1300	.1300	.1174
Division expense.....	.0302	.0090	.0472	.0129	.0191	.0315	.0053	.0083	.0057	.0065	.0150	.0306	.0126
Total division cost.....	.7440	.3211	1.1586	.3711	.5465	.8691	.3141	.3697	.2932	.2676	.4517	.8287	.3895
Administrative and general expense.....	.0573	.0313	.1271	.0260	.0579	.0979	.0151	.0121	.0193	.0139	.0374	.0638	.0296
Total cost.....	.8013	.3524	1.2857	.3971	.6044	.9670	.3292	.3818	.3125	.2815	.4891	.9225	.4191
MIRAFLORES DAM.													
Dry fill.....cubic yards.....	37,820	45,140	17,970	57,265	46,115	42,485	52,195	35,000	43,800	16,215	12,370	11,800	418,375
Tracks.....	\$0.0938	\$0.1046	\$0.2291	\$0.0732	\$0.0931	\$0.1519	\$0.0887	\$0.1148	\$0.1016	\$0.2147	\$0.2815	\$0.2187	\$0.1192
Transportation.....	.0357	.0821	.2290	.0685	.0764	.0613	.1088	.0152	.0585	.0541	.0639	.0696	.0729
Filling.....	.0542	.0619	.1516	.0327	.0684	.0739	.0549	.0843	.0603	.1285	.1016	.1421	.0726
Maintenance of equipment.....	.0392	.0446	.1466	.0498	.0443	.0311	.0707	.0099	.0526	.0573	.0414	.0267	.0509
Plant arbitrary.....	.0800	.0800	.0800	.0800	.0800	.0800	.0700	.0700	.0700	.0700	.0700	.0700	.0700
Division expense.....	.0145	.0131	.0279	.0157	.0158	.0140	.0163	.0114	.0119	.0235	.0271	.0344	.0161
Total division cost.....	.3144	.3853	.8642	.3399	.3780	.4322	.4094	.3056	.3549	.5481	.5855	.5615	.4076
Administrative and general expense.....	.0179	.0210	.0605	.0135	.0261	.0317	.0226	.0422	.0144	.0630	.0534	.0566	.0280
Total cost.....	.3323	.4063	.9247	.3534	.4041	.4639	.4320	.3478	.3693	.6111	.6389	.6181	.4356
MIRAFLORES LOCKS.													
Back filling.....cubic yards.....	73,076	78,689	96,812	70,185	67,497	95,085	111,942	77,637	90,200	89,798	66,190	62,357	979,468
Tracks.....	\$0.1321	\$0.0787	\$0.3772	\$0.1123	\$0.1299	\$0.0771	\$0.0964	\$0.1125	\$0.0695	\$0.0590	\$0.0766	\$0.1015	\$0.0917
Transportation.....	.0406	.0851	.0379	.0787	.0681	.0586	.0529	.0520	.0530	.0560	.0390	.0704	.0533
Filling.....	.0573	.0684	.4203	.0853	.0734	.0632	.0348	.0610	.0409	.0404	.0551	.4808	.1108
Maintenance of equipment.....	.0432	.0463	.0222	.0471	.0330	.0338	.0390	.0122	.0312	.0289	.0270	.0221	.0312
Plant arbitrary.....	.0900	.0900	.0413	.0900	.0900	.0900	.1100	.1100	.1100	.1100	.0581	.0921	.0921
Division expense.....	.0171	.0130	.0088	.0225	.0188	.0102	.0106	.0102	.0085	.0063	.0106	.0191	.0127
Total division cost.....	.3803	.3815	.6077	.4359	.4132	.3349	.3437	.3579	.3131	.3036	.3333	.7588	.4008
Administrative and general expense.....	.0262	.0251	.0188	.0267	.0346	.0257	.0522	.0828	.0200	.0211	.0303	.0342	.0302
Total cost.....	.4065	.4066	.6265	.4626	.4478	.3606	.3959	.4407	.3331	.3247	.3636	.7930	.4400



TABLE 7.—Piles for foundations.

## ATLANTIC DIVISION.

Items.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	Total.
GATUN LOCKS.													
Preparing foundations, wooden piling, linear feet.....						41,220	69,155	17,331	72,813				200,549
Wooden piles in place.....						\$0.5244	\$0.5609	\$0.6315	\$0.2731				\$0.4881
Maintenance of equipment.....						.0017	.0065	.0006	.0146				.0136
Plant arbitrary.....						.0135	.0120	.0120	.0785				.0337
Division expense.....							.0152	.0253	.0125				.0150
Total division cost.....						.5396	.5946	.7294	.3787				.5504
Administrative and general expense.....						.0985	.1123	.0907	.0387				.0816
Total cost.....						.6381	.7075	.8201	.4174				.6320

## PACIFIC DIVISION.

MIRAFLORES LOCKS.													
Preparing foundations, wooden piling, linear feet.....	525	5,740	5,040	1,295	12,145		2,605	3,950	6,825				38,125
Wooden piles in place.....	\$0.5304	\$0.1757	\$0.1529	\$1.0225	\$0.0884		\$0.1604	\$0.2205	\$0.1465				\$0.1473
Division expense.....	.0394	.0121	.0085	.0335	.0062		.0089	.0116	.0068				.0098
Total division cost.....	.5698	.1878	.1614	1.0560	.0946		.1693	.2321	.1533				.1571
Administrative and general expense.....	.0610	.0204	.0176	.0007	.0111		.0138	.0067	.0125				.0174
Total cost.....	.6308	.2082	.1790	1.0567	.1057		.1831	.2418	.1658				.1745

EXHIBIT B.—DETAIL COST PER UNIT OF WORK BY MONTHS—FISCAL YEAR 1913—Continued.  
TABLE 8.—Breakwaters.  
ATLANTIC DIVISION.

Items.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	Total.
<b>COLON BREAKWATER.</b>													
Quarrying Porto Bello large rock, cu. yds.	8, 678	9, 332	8, 711	14, 313	12, 389	16, 034	18, 383	17, 633	19, 321	19, 515	19, 772	19, 681	183, 762
Stripping.....	\$0. 7565	\$0. 5348	\$0. 7437	\$0. 4649	\$0. 5729	\$0. 3588	\$0. 2955	\$0. 3179	\$0. 3327	\$0. 3562	\$0. 3363	\$0. 4177	\$0. 4178
Drilling.....	1841	1321	1817	1287	1298	1074	1026	1370	0907	0814	0614	1014	1087
Blasting.....	3739	3145	3929	2255	3063	2311	2440	2375	1674	1468	2034	1266	2259
Loading.....	1883	1804	1723	1064	1192	1141	1249	1111	1301	1104	1270	1246	1978
Transportation.....	1833	2009	1931	6978	1105	1223	1385	1294	1380	1271	1658	1613	1427
Trucks.....	4540	4756	6818	4097	4287	3418	2170	2436	3750	4831	4736	3714	3662
Loading on barges.....	1848	2791	7197	1921	1787	1572	1565	1475	1380	1321	1599	2215	1896
Power.....	1919	1753	1891	1256	1030	1194	1182	1283	0918	1144	1181	1344	1257
Maintenance of equipment.....	4028	3846	6824	6085	4109	5755	8023	4663	5011	7981	4811	7763	6287
Plant arbitrary.....	3010	3010	3010	3010	3010	3010	3320	3320	3320	3320	3320	3320	3303
Total.....	3, 2151	3, 4983	3, 5907	2, 6765	2, 6500	2, 3909	2, 5715	2, 2426	2, 3274	2, 7016	2, 4461	2, 7682	2, 6394
<b>Towing:</b>													
Operation, tugs and barges.....	6324	3720	4687	3089	3405	2504	1599	2912	1573	2907	2883	2558	2829
Maintenance of equipment.....	2731	2153	2189	3664	4454	1372	0370	2316	0681	1456	0420	1797	1780
Plant arbitrary.....	4040	4040	4040	4040	4040	4040	3840	3840	3840	3840	3840	3840	3916
Total.....	1, 3095	9913	1, 0916	1, 0793	1, 1899	7916	6009	9268	6094	8293	7143	8195	8525
<b>Placing:</b>													
Operation of floating derricks.....	2066	3371	2837	1295	1600	1140	1432	1237	1111	1407	2365	2067	1716
Maintenance, floating derricks.....	0263	0867	0859	2182	0643	0394	0181	0527	1849	1366	0188	1478	0932
Operation, cranes.....	1824	1688	1844	1488	1620	1448	1424	1574	1680	1715	1356	1430	1562
Operation, trains.....	0855	1008	0878	0715	0972	0784	0754	0822	0777	0731	0563	0408	0741
Dumping.....	0912	0172	0160	0148	0124	0091	0082	0064	0075	0087	0112	0115	0143
Maintenance of equipment.....	1935	1415	2154	2468	1557	1885	1324	2029	0804	1030	0870	1040	1453
Plant arbitrary.....	1641	1640	1640	1640	1640	1640	1300	1500	1500	1500	1500	1500	1553
Total.....	9496	1, 0161	1, 0392	9936	8156	7382	6697	7753	7799	7836	6954	8038	8100
<b>Trestles:</b>													
Tug service, miscellaneous.....	7612	3011	2293	2112	1484	1680	0623	1110	1236	1081	0732	1008	1753
Maintenance of equipment, miscellaneous.....	0390	0390	1569	0854	1545	0633	0782	0620	0439	0620	0393	0409	0840
Division expense.....	3490	3363	3161	3271	3191	1938	1281	1400	0697	0316	0004	0082	2045
Total division cost.....	6, 3844	6, 4669	6, 487	5, 4796	5, 4304	4, 4069	4, 1794	4, 3119	4, 0043	4, 6632	4, 1440	4, 7314	4, 8250
Administrative and general expense.....	4688	6340	6422	2106	5208	4021	3855	4244	3748	4208	3461	3137	4056
Total cost, large rock.....	7, 0532	7, 1009	7, 1289	5, 6902	5, 9512	4, 8090	4, 5649	4, 7363	4, 3791	5, 0840	4, 4904	5, 0451	5, 2306

TABLE 9.—*Stone production.*

## PACIFIC DIVISION.

Items.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	Total.
ANCON QUARRY.													
Quarrying..... cubic yards..	61,053	70,383	41,379	61,604	54,048	56,620	70,188	61,544	65,743	50,092	29,274	54,446	688,301
Stripping.....	\$0.0275	\$0.0057	\$0.0028	\$0.0002	\$0.0003	\$0.0003	\$0.0009	\$0.0228	\$0.0732	\$0.0465	\$0.0029	\$0.0120	\$0.0206
Drilling.....	.0506	.0720	.0788	.0611	.0619	.0649	.0339	.0795	.0399	.1808	.2437	.1261	.0822
Blasting.....	.0865	.0736	.0614	.0386	.0536	.0489	.0322	.0582	.0505	.0709	.0908	.0607	.0660
Loading.....	.0448	.0374	.0308	.0416	.0440	.0416	.0411	.0402	.0308	.0460	.0450	.0378	.0451
Transportation.....	.0500	.0515	.0692	.0362	.0562	.0550	.0318	.0385	.0561	.0699	.1077	.0548	.0446
Tracks.....	.0315	.0464	.0449	.0303	.0320	.0286	.0240	.0335	.0444	.0303	.0986	.1025	.0446
Maintenance of equipment.....	.0317	.0400	.0776	.0473	.0836	.0316	.0638	.0628	.0611	.0659	.1306	.0801	.0637
Plant arbitrary.....	.1600	.1600	.1600	.1600	.1600	.1600	.1000	.1000	.1000	.1000	.1000	.1000	.1301
Total.....	.5426	.4926	.5574	.4251	.5016	.4309	.3907	.4615	.4760	.6103	.9153	.5940	.5035
Crushing:													
Operation crushers.....	.0184	.0184	.0311	.0156	.0241	.0178	.0242	.0249	.0216	.0213	.0540	.0432	.0242
Stone bins and conveyors.....	.0046	.0037	.0057	.0039	.0045	.0040	.0040	.0044	.0043	.0049	.0154	.0046	.0047
Power.....	.0166	.0182	.0223	.0190	.0184	.0202	.0168	.0196	.0197	.0195	.0343	.0246	.0197
Maintenance of equipment.....	.0235	.0163	.1142	.0447	.0076	.0566	.0196	.0083	.0233	.0653	.1027	.1026	.0425
Plant arbitrary.....	.0425	.0427	.0432	.0428	.0426	.0428	.0240	.0250	.0222	.0221	.0200	.0200	.0321
Total.....	.1106	.0993	.2165	.1260	.0972	.1414	.0865	.0792	.0911	.1331	.2264	.1950	.1232
Rail transportation to storage:													
Operation of trains.....	.0275	.0462	.0561	.0467	.0546	.0484	.0367	.0361	.0329	.0297	.0599	.0397	.0409
Dumping in storage.....	.0083	.0298	.0298	.0200	.0424	.0104	.0170	.0177	.0141	.0157	.0438	.0662	.0199
Maintenance of equipment.....	.0264	.0222	.0311	.0271	.0245	.0232	.0209	.0166	.0164	.0138	.0249	.0116	.0211
Plant arbitrary.....	.0600	.0600	.0600	.0600	.0600	.0600	.0400	.0400	.0400	.0400	.0400	.0400	.0501
Total.....	.1222	.1582	.1770	.1538	.1815	.1440	.1146	.1104	.1034	.0992	.1086	.1005	.1320
Division expense.....													
Total cost in storage.....	.0244	.0186	.0208	.0229	.0228	.0146	.0154	.0151	.0168	.0276	.0410	.0273	.0208
Total cost in storage.....	.7998	.7687	.9717	.7278	.8031	.7309	.6072	.6662	.6873	.8702	.3513	.9168	.7795

NOTE.—Under "Total," 11,927 cubic yards have been added to adjust difference between cross-section measurements of stock pile and book balance. This amount was not added to monthly quantities.

## EXHIBIT B.—DETAIL COST PER UNIT OF WORK BY MONTHS—FISCAL YEAR 1913—Continued.

TABLE 10.—*Sand production.*

## ATLANTIC DIVISION.

Items.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	Total.
<b>GATUN.</b>													
Dredging.....cubic yards..	30, 118	2, 850							10, 883				43, 851
Operation, dredges.....	\$0.2008	\$0.3286							\$0.2827				\$0.2298
Maintenance of equipment.....	.0121	.0847							.0791				.0309
Total.....	.2129	.4133							.3618				.2607
Towing.....cubic yards..	20, 520	2, 850							10, 883				34, 253
Operation, tugs and barges.....	\$0.0770	\$0.2571							\$0.1102				\$0.1186
Maintenance of equipment.....	.0012	.0228							.0077				.0053
Total.....	.0782	.2799							.1179				.1239
Unloading.....cubic yards..	20, 520	2, 850							10, 883				34, 253
Operation, cableways and crane.....	\$0.0748	\$0.0509							\$0.0625				\$0.0839
Power.....	.0262	.0102							.0142				.0234
Maintenance of equipment.....	.0493	.0223							.0426				.0479
Total.....	.1503	.0834							.1193				.1532
Rail transportation to storage..cubic yards	1, 010	380											1, 390
Operation of cranes.....	\$0.2373	\$0.1038											\$0.2008
Operation of trains.....	.0825	.0602											.0764
Maintenance of equipment.....	.2088	.6323											.8635
Total.....	.5286	.8263											.6407
Division expense.....	.0154	.0539							.0129				.0172
Total cost in storage.....	.4017	.9407							.6119				.5188

## PACIFIC DIVISION.

CHAME.													
Dredging.....cubic yards..	51,470	49,111	39,385	41,986	35,821	38,870	46,318	35,039	31,798	24,454	21,776	29,630	445,658
Operation, dredges.....	\$0.0703	\$0.0762	\$0.0943	\$0.0913	\$0.0931	\$0.0825	\$0.0776	\$0.0959	\$0.1035	\$0.1222	\$0.1495	\$0.0954	\$0.0915
Maintenance of equipment.....	.1489	.0272	.0223	.0168	.0265	.0215	.0360	.0231	.0291	.1501	.2703	.0115	.0376
Total.....	.2192	.1034	.1166	.1081	.1196	.1040	.1136	.1190	.1326	.2723	.4198	.1069	.1491
Plant arbitrary.....	.0100	.0100	.0100	.0100	.0100	.0100	.0066	.0066	.0066	.0066	.0066	.0066	.0086
Total cost of production.....	.2292	.1134	.1266	.1181	.1296	.1140	.1202	.1256	.1392	.2789	.4264	.1135	.1577
Towing.....cubic yards..	51,470	49,111	39,385	41,986	35,821	38,870	46,318	35,039	31,798	24,454	21,776	29,630	445,658
Operation, tugs and barges.....	\$0.1009	\$0.1028	\$0.1341	\$0.0905	\$0.0951	\$0.0898	\$0.0914	\$0.1170	\$0.1412	\$0.1355	\$0.1311	\$0.1067	\$0.1085
Maintenance of equipment.....	.0783	.0960	.0446	.0489	.0362	.0334	.0158	.0210	.0610	.0754	.1274	.0393	.0802
Plant arbitrary.....	.0200	.0200	.0200	.0200	.0200	.0200	.0134	.0134	.0134	.0134	.0134	.0134	.0171
Total.....	.1992	.1788	.1987	.1594	.1513	.1432	.1206	.1514	.2156	.2243	.2719	.1594	.1758
Unloading.....cubic yards..	50,470	48,611	38,985	40,986	35,821	38,370	45,318	33,539	30,298	23,454	20,776	29,630	435,758
Operation, cableways and cranes.....	\$0.0618	\$0.0808	\$0.0924	\$0.0960	\$0.1045	\$0.0861	\$0.0592	\$0.0824	\$0.0811	\$0.1153	\$0.1215	\$0.0901	\$0.0859
Power.....	.0147	.0151	.0204	.0182	.0187	.0179	.0126	.0166	.0177	.0169	.0218	.0170	.0169
Maintenance of equipment.....	.0275	.0312	.1084	.0295	.1285	.0366	.0178	.0236	.0200	.0884	.0353	.0399	.0475
Plant arbitrary.....	.0515	.0511	.0513	.0514	.0513	.0512	.0108	.0109	.0113	.0110	.0100	.0100	.0342
Total.....	.1555	.1782	.2725	.1951	.3030	.1918	.1004	.1335	.1301	.2416	.1886	.1570	.1845
Rail transportation to storage..cubic yards..	50,470	48,611	38,985	40,986	35,821	38,370	45,318	33,539	30,298	23,454	20,776	29,630	435,758
Operation of trains.....	\$0.0243	\$0.0440	\$0.0512	\$0.0484	\$0.0541	\$0.0518	\$0.0464	\$0.0491	\$0.0337	\$0.0389	\$0.0588	\$0.0408	\$0.0444
Repairs to tracks.....	.0506	.0092	.0013	.0309	.0243	.0271	.1538	.0461	.2326	.0665	.0215	.0051	.0049
Dumping in storage.....	.0103	.0085	.0127	.0101	.0147	.0262	.0438	.0289	.0176	.0219	.0138	.0108	.0183
Maintenance of equipment.....	.0238	.0227	.0296	.0294	.0249	.0275	.0270	.0236	.0174	.0188	.0254	.0126	.0241
Plant arbitrary.....	.0400	.0400	.0400	.0400	.0400	.0400	.0200	.0200	.0200	.0200	.0200	.0200	.0316
Total.....	.1400	.1244	.1348	.1588	.1580	.1726	.2910	.1677	.3213	.1661	.1395	.0893	.1733
Division expense.....	.0136	.0106	.0097	.0236	.0253	.0122	.0170	.0176	.0312	.0306	.0325	.0249	.0198
Total cost in storage.....	.7485	.6054	.7423	.6550	.7672	.6338	.6492	.5958	.8374	.9475	1.0589	.5441	.7111

## EXHIBIT B.—DETAIL COST PER UNIT OF WORK BY MONTHS—FISCAL YEAR 1913—Continued.

TABLE 11.—Operation of power plants, fiscal year ended June 30, 1913.

## ATLANTIC DIVISION.

	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	Total.
GATUN POWER PLANT.													
Output.....kilowatt hours..	1,259,570	1,247,280	745,160	738,720	743,670	788,360	887,270	805,520	885,520	757,280	768,980	688,460	10,315,790
Operation.....	\$0.0017	\$0.0017	\$0.0032	\$0.0031	\$0.0029	\$0.0023	\$0.0023	\$0.0024	\$0.0024	\$0.0027	\$0.0026	\$0.0029	\$0.0024
Fuel.....	.0080	.0082	.0082	.0085	.0080	.0081	.0079	.0079	.0080	.0081	.0081	.0078	.0081
Repairs to equipment.....	.0008	.0011	.0023	.0017	.0008	.0004	.0008	.0007	.0006	.0008	.0022	.0014	.0011
Plant arbitrary.....	.0040	.0040	.0040	.0040	.0040	.0040	.0015	.0015	.0015	.0009	.0009	.0010	.0027
Division expense.....	.0002	.0001	.0003	.0004	.0004	.0002	.0002	.0002	.0002	.0003	.0003	.0004	.0003
Total.....	.0147	.0151	.0180	.0177	.0161	.0150	.0127	.0127	.0127	.0128	.0141	.0135	.0146

## PACIFIC DIVISION.

	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	Total.
MIRAFLORES POWER PLANT.													
Output.....kilowatt hours..	979,390	995,265	837,630	978,090	776,500	722,150	911,720	873,430	909,020	858,570			8,841,765
Operation.....	\$0.0021	\$0.0022	\$0.0024	\$0.0027	\$0.0031	\$0.0036	\$0.0026	\$0.0030	\$0.0026	\$0.0030			\$0.0027
Fuel.....	.0079	.0081	.0079	.0078	.0082	.0081	.0076	.0077	.0078	.0078			.0079
Repairs to equipment.....	.0006	.0011	.0014	.0005	.0007	.0005	.0006	.0012	.0009	.0007			.0008
Plant arbitrary.....	.0090	.0090	.0090	.0090	.0090	.0090	.0070	.0070	.0070	.0070			.0082
Division expense.....	.0002	.0002	.0002	.0003	.0003	.0002	.0002	.0002	.0002	.0003			.0002
Total.....	.0198	.0206	.0209	.0203	.0213	.0214	.0180	.0191	.0185	.0188			.0198

<sup>1</sup> On May 1 this plant was transferred to the mechanical division. Costs for May and June are shown in annual report of the mechanical division.



## EXHIBIT C.—DETAILED COST OF WORK DONE BY FIRST AND SECOND DIVISIONS AND ON PERMANENT TOWN SITES AND BUILDINGS, TO JUNE 30, 1913.

TABLE 1.—Detailed cost of gates, caissons, emergency dams, and operating machinery, etc., including installation, to June 30, 1913.

CHIEF ENGINEER'S OFFICE, FIRST DIVISION.

	Amount.		
	Gatun.	Pedro Miguel.	Miraflores.
Spillway gates and caisson:			
Inspection on Isthmus.....	\$1,906.28		\$408.51
Gates—			
Contract payments.....	49,509.20		34,364.87
Installation.....	15,371.86		26.21
Division expense.....	769.16		
Total gates.....	65,650.22		34,391.08
Caisson—			
Contract payments.....	5,690.00		5,690.00
Ballast.....	388.41		130.83
Installation.....	97.31		5.27
Total caisson.....	6,175.72		5,826.10
Administrative and general expense.....	2,738.61		
Total spillway gates and caisson.....	76,470.83		40,625.69
Spillway-gate machines:			
Number of machines.....	14		6
Per cent complete—			
Mechanical erection.....	65.00		
Electrical installation.....	2.00		
Inspection in the United States.....	\$1,955.25		\$304.44
Inspection on the Isthmus.....	41.32		33.48
Contract payments.....	77,588.26		62,082.54
Installation expenses—			
Surveys.....	660.86		
Mechanical erection.....	5,502.41		
Electrical installation.....	330.74		
Testing.....	482.94		
Miscellaneous expenses.....	3,835.25		1,735.00
Division expense.....	628.04		143.76
Total installation expenses.....	11,440.24		1,878.76
Preliminary maintenance and operation.....	97.88		
Administrative and general expense.....	1,641.34		1,346.32
Total spillway-gate machines.....	92,764.29		65,645.54
Lock gates:			
Inspection in the United States.....	52,230.88	\$42,629.30	33,609.24
Inspection on the Isthmus.....	31,374.29	11,615.67	9,134.24
Contract payments.....	1,862,444.95	1,097,026.06	1,105,921.00
Extra payments to contractors.....	517.16	160.00	
Seals.....	9,986.91	1,413.70	
Fixed steel.....	46,960.66	884.01	164.34
Gate recess covers—			
Material.....	58,301.33	35,332.45	36,366.27
Installation.....	13,682.14	6,707.07	1,224.00
Construction tracks.....	50,086.84	8,752.67	8,843.22
Power, fuel, and water.....	62,444.84	51,431.23	26,880.77
Freight and handling.....	27,168.91	7,767.13	7,243.69
Miscellaneous.....	1,683.10	322.42	1,359.33
Painting.....	2,757.36	3,344.71	2,177.06
Spare parts.....		104,646.23	
Division expense.....	5,444.93	1,504.48	922.21
Total division cost.....	2,225,084.30	1,373,537.13	1,233,845.37
Administrative and general expense.....	65,871.72	8,681.17	17,645.86
Total lock gates.....	2,290,956.02	1,382,218.30	1,251,491.23
Fender chains:			
Inspection in the United States.....	760.00		
Installation.....	2,922.95	21.37	
Testing.....	154.00		
Total fender chains.....	3,836.95	21.37	

## EXHIBIT C.—DETAILED COST OF WORK DONE BY FIRST AND SECOND DIVISIONS AND ON PERMANENT TOWN SITES AND BUILDINGS, TO JUNE 30, 1913—Continued.

TABLE 1.—Detailed cost of gates, caissons, emergency dams, and operating machinery, etc., including installation, to June 30, 1913—Continued.

	Amount.		
	Gatun.	Pedro Miguel.	Miraflores.
Emergency dams:			
Inspection in the United States.....	\$32,223.16	\$23,283.06	\$19,805.20
Inspection on the Isthmus.....	9,964.79	3,576.27	1,487.43
Contract payments.....	699,254.89	466,678.53	.....
Spare parts.....	529.00	.....	.....
Foundations and fixed steel.....	47,065.63	10,878.78	8,356.62
Concrete counterweight.....	10,686.40	3,572.02	.....
Operator's house.....	605.94	156.61	.....
Switchboard house.....	739.01	.....	.....
Electrical installation.....	178.20	38.40	38.40
Construction tracks.....	4,872.13	1,348.49	8,287.14
Freight and handling.....	3,560.12	1,195.63	411.47
Power.....	1,658.06	958.12	359.29
Grouting material.....	563.80	321.36	52.88
Painting.....	1,829.39	429.00	.....
Division expense.....	2,454.25	44.20	5.32
Total division cost.....	816,184.77	512,480.47	38,803.75
Administrative and general expense.....	6,493.97	382.02	553.69
Total emergency dams.....	822,678.74	512,862.49	39,357.44
Operating machinery:			
Inspection in the United States.....	55,578.35	19,967.97	38,612.06
Inspection on the Isthmus.....	5,250.46	1,752.55	4,165.35
Testing.....	34,662.65	11,594.64	2,649.75
Miter-gate machines—			
Miter-gate moving machines, mechanical—			
Number of machines.....	40	24	28
Per cent complete—			
Mechanical erection.....	92.00	86.00	77.00
Electrical installation.....	16.00	38.00	.....
Contract payments.....	\$313,101.46	\$187,769.05	\$206,270.02
Installation expenses:			
Surveys.....	1,970.94	948.83	429.14
Erection.....	20,844.47	13,048.05	6,454.39
Miscellaneous expenses.....	22,795.78	10,745.51	11,185.83
Division expense.....	3,331.77	1,980.76	1,186.41
Total installation expenses.....	48,942.96	26,723.15	19,255.77
Total miter-gate moving machines, mechanical.....	362,044.42	214,492.20	225,525.79
Miter-forcing machines, mechanical—			
Number of machines.....	20	12	14
Per cent complete—			
Mechanical erection.....	10.00	5.00	.....
Electrical installation.....	21.00	15.00	.....
Contract payments.....	\$13,796.15	\$10,072.44	\$6.77
Installation expenses:			
Surveys.....	2.01	.....	5,036.22
Erection.....	1,333.60	1.52	.....
Miscellaneous expenses.....	1,808.21	1,314.42	448.77
Division expense.....	209.43	73.04	21.99
Total installation expenses.....	3,353.25	1,388.98	5,506.98
Total miter-forcing machines, mechanical.....	17,149.40	11,461.42	5,513.75
Handrail machines, mechanical—			
Number of machines.....	40	24	28
Per cent complete:			
Mechanical erection.....	50.00	.....	.....
Electrical installation.....	35.00	13.00	.....
Contract payments.....	\$4,810.75	\$2,474.08	\$8,567.00

## EXHIBIT C.—DETAILED COST OF WORK DONE BY FIRST AND SECOND DIVISIONS AND ON PERMANENT TOWN SITES AND BUILDINGS, TO JUNE 30, 1913—Continued.

TABLE 1.—Detailed cost of gates, caissons, emergency dams, and operating machinery, etc., including installation, to June 30, 1913—Continued.

	Amount.		
	Gatun.	Pedro Miguel.	Miraflores.
Operating machinery—Continued.			
Miter-gate machines—Continued.			
Handrail machines, mechanical—Continued.			
Installation expenses:			
Erection.....	\$706.12		\$321.56
Miscellaneous expenses.....	474.66	\$74.43	
Division expense.....	87.20	6.74	
Total installation expense.....	1,267.98	81.17	321.56
Total handrail machines, mechanical.....	6,078.73	2,555.25	8,888.56
Gate sump pumps, mechanical—			
Number of machines.....	40	24	28
Per cent complete:			
Mechanical erection.....	45.00	41.00	
Contract payments.....	\$6,691.00	\$3,182.95	\$7,914.45
Installation expenses:			
Erection.....	921.51	286.52	
Miscellaneous expenses.....	599.94	205.24	317.77
Division expense.....	97.01	30.32	17.27
Total installation expense.....	1,618.46	522.08	335.04
Total gate sump pumps, mechanical.....	8,309.46	3,705.03	8,249.49
Electrical installation, all gate machines—			
Contract payments.....	\$55,693.08	\$21,007.74	\$39,844.06
Installation expenses:			
Installation (uncompleted).....	10,278.78	3,464.75	358.14
Miscellaneous expenses.....	4,588.57	3,025.69	1,634.86
Division expense.....	1,050.18	420.70	125.87
Total installation expenses.....	15,917.53	6,911.14	2,118.87
Total electrical installation.....	71,610.61	27,918.88	41,962.93
Administrative and general expense.....	15,925.16	7,936.15	7,419.31
Total miter-gate machines.....	481,117.78	268,068.93	297,559.83
Rising stem valves—			
Contract payments.....	\$123,120.99	\$62,824.46	\$95,212.42
Installation expenses—			
Surveys.....	261.53	166.15	218.53
Adjustment fixed irons.....	23,203.80	18,896.82	17,579.25
Installation valves and seals.....	8,930.60	5,967.00	14,351.46
Miscellaneous expenses.....	22,357.35	7,468.08	11,738.58
Division expense.....	4,011.57	2,498.69	2,850.66
Total installation expenses.....	58,764.85	34,996.74	46,738.48
Administrative and general expense.....	11,817.12	5,174.26	7,739.25
Total rising stem valves.....	193,702.96	102,995.46	149,690.15
Rising-stem valve machines—			
Number of machines.....	76	50	62
Per cent complete:			
Mechanical erection.....	99.00	100.00	76.00
Electrical installation.....	48.00	65.00	7.00
Contract payments.....	\$392,579.20	\$165,317.22	\$239,915.42

EXHIBIT C.—DETAILED COST OF WORK DONE BY FIRST AND SECOND DIVISIONS AND ON PERMANENT TOWN SITES AND BUILDINGS, TO JUNE 30, 1913—Continued.

TABLE 1.—Detailed cost of gates, caissons, emergency dams, and operating machinery, etc., including installation, to June 30, 1913—Continued.

	Amount.		
	Gatun.	Pedro Miguel.	Miraflores.
Operating machinery—Continued.			
Rising-stem valve machines—Continued.			
Installation expenses—			
Surveys.....	\$1,668.26	\$1,214.50	\$606.06
Mechanical erection.....	34,584.66	29,167.67	14,193.98
Electrical installation.....	5,678.40	1,901.39	419.27
Miscellaneous expenses.....	33,012.60	14,587.64	16,285.51
Division expense.....	5,688.43	4,206.52	2,135.13
Total installation expenses....	80,632.35	51,077.72	33,639.95
Administrative and general expense.....	20,086.76	9,640.01	10,783.35
Total rising-stem valve machines.....	493,298.31	226,034.95	284,338.72
Cylindrical valves: These valves were installed by the construction divisions at the time of construction of the locks and charged to "Ironwork." The following expenses were incurred by the First Division in adjusting them for operation—			
Contract payments.....		205.00	4,294.11
Installation expenses—			
Adjustment fixed irons.....	1,896.53		1,645.99
Adjustment of valves.....	1,349.34	2,044.06	2,203.84
Painting.....	802.56	215.11	401.78
Miscellaneous expenses.....	968.54	597.45	1,441.35
Division expense.....	399.59	251.83	433.29
Total installation expenses.....	5,416.56	3,108.45	6,126.25
Administrative and general expense.....	749.15	388.62	1,862.82
Total cylindrical valves.....	6,165.71	3,702.07	12,283.18
Cylindrical valve machines—			
Number of machines.....	60	20	40
Per cent complete—			
Mechanical erection.....	100.00	100.00	100.00
Electrical installation.....	40.00	75.00	28.00
Contract payments.....	\$80,504.87	\$31,747.93	\$50,137.73
Installation expenses—			
Surveys.....	150.24	222.03	62.64
Mechanical erection.....	7,070.66	2,810.84	3,789.04
Electrical installation (uncompleted).....	3,959.97	2,373.43	1,810.87
Miscellaneous expenses.....	7,322.53	2,268.43	3,416.96
Division expense.....	1,461.67	630.83	719.47
Total installation expenses.....	19,965.07	8,305.56	9,798.98
Administrative and general expense.....	5,064.21	1,616.87	3,505.38
Total cylindrical valve machines.....	105,534.15	41,670.36	63,442.09
Auxiliary culvert valve machines—			
Number of machines.....	4	4	4
Per cent complete—			
Mechanical erection.....	100.00	100.00	100.00
Electrical installation.....	37.00	72.00	30.00
Contract payments.....	\$5,378.26	\$5,384.74	\$5,276.28
Installation expenses—			
Surveys.....	1.42	74.22	10.40
Mechanical erection (completed).....	746.79	582.05	1,003.21
Electrical installation (uncompleted).....	141.46	495.95	195.87
Miscellaneous expenses.....	523.02	534.47	790.87
Division expense.....	119.02	132.54	146.34
Total installation expenses.....	1,531.71	1,819.23	2,146.69
Administrative and general expense.....	364.05	319.46	423.81
Total auxiliary culvert valve machines....	7,274.02	7,523.43	7,846.87

## EXHIBIT C.—DETAILED COST OF WORK DONE BY FIRST AND SECOND DIVISIONS AND ON PERMANENT TOWN SITES AND BUILDINGS, TO JUNE 30, 1913—Continued.

TABLE 1.—Detailed cost of gates, caissons, emergency dams, and operating machinery, etc.; including installation, to June 30, 1913—Continued.

	Amount.		
	Gatun.	Pedro Miguel.	Miraflores.
Operating machinery—Continued.			
Chain fender machinery—			
Chain fender machines, mechanical—			
Number of machines.....	16	16	16
Per cent complete—			
Mechanical erection.....	\$44.00	\$35.00	\$15.00
Electrical installation.....	5.00		
Contract payments.....	\$27,277.50	\$24,138.94	\$17,193.68
Installation expenses—			
Surveys.....	411.47	382.31	8.14
Erection.....	9,550.47	3,640.09	1,406.34
Miscellaneous expenses.....	4,286.02	1,808.17	1,422.13
Division expenses.....	1,184.48	527.56	181.86
Total installation expenses.....	15,432.44	6,358.13	3,018.47
Total chain fender machines, mechanical.....	42,709.94	30,497.07	20,212.15
Chain fender pit pumps, mechanical—			
Number of machines.....	16	16	16
Per cent complete—Mechanical erection.....	12.00		
Contract payments.....	\$2,965.60	\$2,965.59	\$2,965.61
Installation expenses—			
Erection.....	306.17		
Miscellaneous expenses.....	144.83	59.33	\$3.68
Division expense.....	29.79	8.41	7.96
Total installation expense.....	480.79	97.74	91.64
Total chain fender pit pumps, mechanical.....	3,446.39	3,063.33	3,057.25
Electrical installation (all chain fender machines)—			
Contract payments.....	3,999.25	3,723.00	3,712.00
Installation expenses—			
Installation (uncompleted).....	582.15		
Miscellaneous expenses.....	502.69	360.96	156.59
Division expense.....	74.79	20.64	9.59
Total installation expenses.....	1,159.63	381.60	166.18
Total electrical installation.....	5,158.88	4,104.60	3,878.18
Administrative and general expenses.....	3,301.66	1,497.90	1,089.98
Total chain fender machinery.....	54,616.87	39,162.90	28,237.56
Culvert pumps—			
Number of pumps.....	1	1	1
Per cent complete—Mechanical erection.....	100.00		
Contract payments.....	\$2,808.92	\$2,903.91	\$2,903.92
Installation expenses—			
Erection, mechanical.....	291.07		
Miscellaneous expenses.....	170.09	191.78	105.60
Division expense.....	29.66	13.42	7.92
Total installation expense.....	490.82	205.20	113.52
Administrative and general expense.....	81.41	97.03	83.16
Total culvert pumps.....	3,381.15	3,206.14	3,100.60
Drainage sump pumps—			
Number of pumps.....	3	3	3
Per cent complete—			
Mechanical erection.....	100.00		
Contract payments.....		909.00	

## EXHIBIT C.—DETAILED COST OF WORK DONE BY FIRST AND SECOND DIVISIONS AND ON PERMANENT TOWN SITES AND BUILDINGS, TO JUNE 30, 1913—Continued.

TABLE 1.—Detailed cost of gates, caissons, emergency dams, and operating machinery, etc., including installation, to June 30, 1913—Continued.

	Amount.		
	Gatun.	Pedro Miguel.	Miraflores.
Operating machinery—Continued.			
Drainage sump pumps—Continued.			
Installation expenses—			
Surveys.....	\$26.83		
Mechanical erection.....	259.65		
Miscellaneous expenses.....	53.88	\$100.59	
Division expenses.....	21.12	6.24	
Total installation expenses.....	361.48	106.83	
Administrative and general expenses.....	11.53	40.43	
Total drainage sump pumps.....	373.01	1,056.26	
Cable-pit pumps—Number of pumps.....	3	2	2
Contract payments.....	1,091.04	727.11	\$727.11
Miscellaneous expenses.....	48.34	68.14	26.55
Division expense.....	3.51	4.37	.23
Administrative and general expense.....	35.81	29.28	20.55
Total cable-pit pumps.....	1,178.70	828.90	774.44
Cable vaults—			
Installation expenses—			
Mechanical installation.....		4.46	
Miscellaneous expenditures.....		.67	
Division expense.....		.33	
Total cable vaults.....		5.46	
Foot bridges—			
Miscellaneous expenditures.....		96.64	237.26
Administrative and general expense.....		1.71	
Total foot bridges.....		98.35	237.26
Electric locomotives—			
Contract payments.....	25,085.15		
Installation expenses—			
Mechanical erection.....	354.11		
Testing and preliminary operation.....	853.82		
Miscellaneous expenses.....	1,351.90		
Division expense.....	166.76		
Total installation expense.....	2,726.59		
Administrative and general expense.....	781.38		
Total electric locomotives.....	28,593.12		
Transformer-room equipment—			
Contract payments.....	95,405.50	49,869.53	69,708.25
Installation expenses—			
Surveys.....	8.82		
Mechanical erection.....	355.75	39.97	133.63
Electrical installation (uncompleted).....	6,208.53	2,547.00	1,256.26
Miscellaneous expenses.....	6,396.21	5,257.68	4,393.06
Division expense.....	900.43	486.60	332.08
Total installation expenses.....	13,869.74	8,331.25	6,115.03
Administrative and general expenses.....	3,555.00	1,093.47	1,071.43
Total transformer-room equipment.....	112,830.24	59,894.25	76,894.71
Towing track system—			
Contract payments, mechanical.....	224,220.27	142,920.19	175,085.26
Survey.....	3,797.50	3,964.59	1,782.19
Miscellaneous expenses.....	13,643.04	5,684.50	7,819.27
Tracks without rack—			
Mechanical installation—			
Installation.....	2,151.23	3,675.42	365.93
Miscellaneous expenses.....	449.17	756.79	166.97
Division expense.....	192.31	405.31	125.51
Total.....	2,792.71	4,837.52	658.41
Installed by construction divisions.....	13,959.32	4,794.54	15,189.66
Total tracks without rack.....	16,752.03	9,632.06	15,848.07

## EXHIBIT C.—DETAILED COST OF WORK DONE BY FIRST AND SECOND DIVISIONS AND ON PERMANENT TOWN SITES AND BUILDINGS, TO JUNE 30, 1913—Continued.

TABLE 1.—Detailed cost of gates, caissons, emergency dams, and operating machinery, etc., including installation, to June 30, 1913—Continued.

	Amount.		
	Gatun.	Pedro Miguel.	Miraflores.
Operating machinery—Continued.			
Towing track system—Continued.			
Tracks without rack—Continued.			
Linear feet of track without rack installed by construction divisions.....	10,527	4,333	5,925
Average cost per linear foot.....	\$1.3261	\$1.1065	\$2.5637
Linear feet of track without rack installed by first division.....	1,449	2,043	1,082
Average cost per linear foot.....	\$1.9273	\$2.3678	\$0.6085
Total linear feet of track without rack installed.....	11,976	6,376	7,007
Average cost per linear foot.....	\$1.3988	\$1.5106	\$2.2617
Tracks with rack—			
Mechanical installation—			
Installation.....	34,044.98	19,392.11	13,671.55
Chipping-rack teeth.....	3,480.92		
Miscellaneous expenses.....	7,493.82	3,359.60	2,588.74
Division expense.....	3,548.35	1,866.32	1,116.05
Total tracks with rack.....	48,568.07	24,618.03	17,376.34
Linear feet of rack track installed.....	21,000	12,199	14,137
Average cost per linear foot.....	\$2.3128	\$2.0180	\$1.2291
Electrical installation, all tracks—			
Contract payments.....	75,548.76	46,850.29	61,681.73
Installation expenses—			
Installation.....	12,755.98	7,781.49	3,707.08
Miscellaneous expenses.....	7,284.40	3,087.39	2,837.63
Division expense.....	1,423.33	945.07	491.54
Total installation expenses.....	21,463.71	11,813.95	7,036.25
Total electrical installation—all tracks.....	97,012.47	58,664.24	68,717.98
Total tracks.....	403,993.32	245,483.61	286,629.11
Crossovers—			
Contract payments.....	7,633.00	4,021.00	9,794.00
Installation expenses—			
Surveys.....	28.76		83.40
Mechanical installation.....	769.25	724.88	188.04
Electrical installation.....	93.43	27.84	
Miscellaneous expenses.....	960.70	457.86	426.44
Division expense.....	137.78	111.53	50.08
Total installation expenses.....	1,989.92	1,322.11	747.96
Total crossovers.....	9,622.92	5,343.11	10,541.96
Bumping posts—			
Contract payments.....	135.00	270.00	
Installation expenses—			
Installation.....	23.14		
Miscellaneous expenses.....	12.06	22.85	
Division expenses.....	3.23	1.85	
Total installation expenses.....	38.43	24.70	
Total bumping posts.....	173.43	294.70	
Administrative and general expenses.....	13,226.35	6,592.92	5,390.68
Total towing track system.....	427,016.08	257,714.34	302,561.75
Screens—			
Contract payments.....	4,678.40	4,821.96	3,706.62

## EXHIBIT C.—DETAILED COST OF WORK DONE BY FIRST AND SECOND DIVISIONS AND ON PERMANENT TOWN SITES AND BUILDINGS, TO JUNE 30, 1913—Continued.

TABLE 1.—*Detailed cost of gates, caissons, emergency dam, and operating machinery, etc., including installation, to June 30, 1913—Continued.*

	Amount.		
	Gatun.	Pedro Miguel.	Miraflores.
Operating machinery—Continued.			
Screens—Continued.			
Installation expenses—			
Assembling.....	\$163.52	\$1,831.07	\$5.03
Miscellaneous expenses.....	320.65	675.04	135.68
Division expense.....	35.68	160.41	10.72
Total installation expenses.....	519.85	2,666.52	151.43
Administrative and general expenses.....	183.28	132.56	102.06
Total screens.....	5,381.53	7,621.04	3,960.11
Decking machinery chambers—			
Contract payments.....	47,413.87	37,781.27	15,219.26
Installation expenses—			
Surveys.....	50.39	182.58	.....
Setting and riveting.....	7,846.24	3,941.15	3,102.25
Miscellaneous expenses.....	5,465.05	3,170.59	1,490.33
Division expense.....	808.96	368.95	135.55
Total installation expenses.....	14,170.64	7,663.27	4,728.13
Administrative and general expenses.....	2,399.74	879.99	407.10
Total decking machinery chambers.....	63,984.25	46,324.53	20,354.49
Decking approach walls—			
Contract payments.....		25,596.06	.....
Installation expenses—			
Surveys.....	67.04	542.63	193.39
Setting and riveting.....		10,716.12	1,830.68
Miscellaneous expenses.....	13.65	3,056.04	471.73
Division expense.....	5.58	1,127.48	196.03
Total installation expenses.....	86.27	15,442.27	2,691.83
Administrative and general expenses.....	7.40	1,997.05	440.62
Total decking approach walls.....	93.67	43,035.38	3,132.45
Recess covers—			
Per cent completed.....	100.00	95.00	74.00
Contract payments.....	\$8,437.33	\$3,975.71	\$10,224.31
Installation expenses—			
Surveys.....	283.36	238.39	69.57
Setting and installing.....	2,500.01	2,837.59	7,090.76
Miscellaneous expenses.....	1,236.79	1,412.98	561.28
Division expense.....	297.95	348.53	92.05
Total installation expenses.....	4,318.11	4,837.49	7,813.66
Administrative and general expenses.....	866.42	706.04	448.21
Total recess covers.....	13,621.86	9,519.24	18,486.18
Machinery chambers (refacing)—			
Refacing—			
Aligning walls and kalsomining.....	6,473.91	564.83	.....
Miscellaneous expenses.....	1,179.24	153.84	.....
Division expense.....	551.23	39.06	.....
Total.....	8,204.38	757.73	.....
Administrative and general expenses.....	1,083.96	85.15	.....
Total machinery chambers (refacing).....	9,288.34	842.88	.....
Power cables—			
Contract payments.....	263,328.45	60,987.72	123,995.71



## EXHIBIT C.—DETAILED COST OF WORK DONE BY FIRST AND SECOND DIVISIONS AND ON PERMANENT TOWN SITES AND BUILDINGS, TO JUNE 30, 1913—Continued.

TABLE 1.—Detailed cost of gates, caissons, emergency dams, and operating machinery, etc., including installation, to June 30, 1913—Continued.

	Amount.		
	Gatun.	Pedro Miguel.	Miraflores.
Operating machinery—Continued.			
Power cables—Continued.			
Installation expenses—	\$1.50		
Surveys.....	12,972.46	\$4,687.86	\$2,422.05
Installation and repairs to ducts.....	10,277.83	6,323.08	1,399.18
Pulling and splicing.....	17,890.97	6,964.02	30,158.40
Miscellaneous expenses.....	3,034.25	1,381.98	649.17
Division expense.....			
Total installation expenses.....	44,177.31	19,356.94	34,628.80
Administrative and general expenses.....	10,649.01	3,502.90	3,770.15
Total power cables.....	318,154.77	83,847.56	162,394.66
Linear feet of cable pulled.....	329,387	106,168	59,605
Cost of pulling and splicing per linear foot.....	\$0.0312	\$0.0596	\$0.0235
Lighting—			
Contract payments.....	\$7,465.37	\$4,563.97	\$9,014.47
Installation expenses—			
Interior lighting and wiring.....	575.77	937.79	
Exterior lighting and wiring.....	98.41	201.84	
Miscellaneous expenses.....	793.55	1,213.23	532.38
Division expense.....	99.18	179.31	29.01
Total installation expenses.....	1,566.91	2,532.17	561.39
Administrative and general expenses.....	245.76	314.99	166.90
Total lighting.....	9,278.04	7,411.13	9,742.76
Lamp-posts—			
Installation expenses—			
Surveys.....	191.95		
Excavation for foundations.....	2,133.65	739.12	479.92
Setting posts.....	3,348.40	15.48	.34
Reflectors.....	176.25	12.37	
Miscellaneous expenses.....	647.95	118.61	77.20
Division expense.....	146.77	59.85	47.23
Total installation expenses.....	6,644.97	945.43	604.69
Administrative and general expenses.....	214.04	65.19	84.87
Total lamp-posts.....	6,859.01	1,010.62	689.56
Caisson sills, adjustment—			
Installation expenses—			
Surveys.....	16.63		
Adjusting.....	8,462.35	2,485.04	632.89
Concreting.....	579.43	601.57	136.17
Miscellaneous expenses.....	4,301.79	3,539.32	3,085.75
Division expense.....	450.22	278.43	71.31
Total installation expenses.....	13,810.42	6,904.36	3,926.12
Administrative and general expenses.....	1,023.87	542.19	56.61
Total caisson sills, adjustment.....	14,834.29	7,446.55	3,982.73
Buffer timbers, material on hand.....	5,839.34	2,130.51	
Preliminary maintenance and operation—			
Maintenance and operation.....	3,684.94	3,884.74	731.76
Miscellaneous expenditures.....	577.98	758.48	97.94
Division expense.....	293.60	348.88	53.92
Administrative and general expenses.....	520.76	1,109.38	112.76
Total preliminary maintenance and operation.....	5,077.28	6,101.48	996.38
Spare parts, material on hand.....		23,056.49	4.49
Total machinery installation.....	2,462,985.94	1,283,624.37	1,496,138.04

EXHIBIT C.—DETAILED COST OF WORK DONE BY FIRST AND SECOND DIVISIONS AND ON PERMANENT TOWN SITES AND BUILDINGS, TO  
JUNE 30, 1913—Continued.

TABLE 2.—Detailed cost of masonry laid to June 30, 1913.

	Gatun.			Pedro Miguel.			Miraflores.		
	Quantity.	Amount.	Unit cost.	Quantity.	Amount.	Unit cost.	Quantity.	Amount.	Unit cost.
<b>In erection of machines:</b>									
Cement.....	<i>Cubic yards.</i> 3,585.2	\$8,439.42	\$2.3474	<i>Cubic yards.</i> 2,763.2	\$5,675.76	\$2.0542	<i>Cubic yards.</i> 2,311.89	\$4,022.29	\$1.7398
Sand.....	3,585.2	1,664.05	.4629	2,763.2	1,343.16	.4860	2,311.89	1,073.79	.4645
Stone.....	3,585.2	3,484.00	.9690	2,763.2	2,137.53	.7735	2,311.89	1,987.75	.8598
Gravel.....	3,585.2	1,831.10	.5093	2,763.2	1,801.89	.6521	2,311.89	1,245.54	.5387
Mixing.....	3,585.2	3,857.70	1.0731	2,763.2	1,801.89	.6521	2,311.89	1,245.54	.5387
Total first division.....	3,585.2	19,276.27	5.3617	2,763.2	10,958.34	3.9658	2,311.89	8,329.37	3.6028
From construction divisions.....	1,512.0	11,672.82	7.7201				210.00	1,502.27	7.1537
<b>Total cost concrete.....</b>									
Forms.....	5,107.2	30,949.09	6.0598	2,763.2	10,958.34	3.9658	2,521.89	9,831.64	3.8985
Placing and chipping.....	5,107.2	13,640.86	2.6709	2,763.2	11,646.65	4.2149	2,521.89	10,706.44	4.2454
Reinforcements.....	5,107.2	12,820.18	2.5102	2,763.2	9,583.86	3.4612	2,521.89	7,082.87	2.8086
Repairs to equipment.....	5,107.2	204.90	.0401	2,763.2	153.40	.0555	2,521.89	34.28	.0135
Division expense.....	5,107.2	845.81	.1656	2,763.2	443.87	.1606	2,521.89	586.75	.2326
Total division cost.....	5,107.2	2,371.76	.4645	2,763.2	1,639.36	.5933	2,521.89	1,277.49	.5067
Administrative and general expense.....	5,107.2	60,832.60	11.9111	2,763.2	34,405.48	12.4513	2,521.89	29,519.47	11.7053
Total cost.....	5,107.2	5,165.60	1.0115	2,763.2	3,139.14	1.1360	2,521.89	2,627.70	1.0419
<b>Total cost.....</b>	5,107.2	65,998.20	12.9226	2,763.2	37,544.62	13.5873	2,521.89	32,147.17	12.7472
<b>In decking machinery chambers and recess covers:</b>									
Cement.....	4,274.0	11,243.55	2.6307	3,028.6	5,242.52	1.7310	1,350.8	2,529.44	1.8725
Sand.....	4,274.0	1,264.83	.2959	3,028.6	1,358.85	.4486	1,350.8	792.36	.5865
Stone.....	4,274.0	2,377.57	.5562	3,028.6	1,932.14	.6379	1,350.8	1,111.13	.8226
Gravel.....	4,274.0	2,698.58	.6314	3,028.6	1,884.47	.6223	1,350.8	374.75	.2775
Mixing.....	4,274.0	3,712.94	.8688	3,028.6	1,884.47	.6223	1,350.8	374.75	.2775
Total first division.....	4,274.0	21,297.47	4.9830	3,028.6	10,417.98	3.4398	1,350.8	4,807.68	3.5591
From construction divisions.....	689.5	4,396.40	6.3762				208.0	1,233.30	5.9293
<b>Total cost concrete.....</b>									
Forms.....	4,963.5	25,693.87	5.1766	3,028.6	10,417.98	3.4398	1,558.8	6,040.98	3.8754
Placing and chipping.....	4,963.5	42,080.52	8.4779	3,028.6	17,867.05	5.8994	1,558.8	9,238.36	5.9266
Reinforcements.....	4,963.5	10,282.88	2.0717	3,028.6	5,669.08	1.8724	1,558.8	3,616.44	2.3200
Total division cost.....	4,963.5	1,572.20	.3168	3,028.6	256.06	.0845	1,558.8	207.22	.1330

Repairs to equipment.....	4,963.5	1,085.02	2186	3,028.6	543.42	1,794	1,558.8	506.63	3250
Division expense.....	4,963.5	4,200.59	8463	3,028.6	1,932.03	6379	1,558.8	927.87	5852
Total division cost.....	4,963.5	84,915.08	17,1079	3,028.6	36,686.52	12,1134	1,558.8	20,537.50	13,1752
Administrative and general expense.....	4,963.5	9,503.35	1,9146	3,028.6	3,344.85	1,1044	1,558.8	1,668.05	1,0700
Total cost.....	4,963.5	94,418.43	19,0225	3,028.6	40,031.37	13,2178	1,558.8	22,205.55	14,2452
In track system and approach walls:									
Cement.....	4,932.4	8,932.74	1,8110	4,398.3	8,532.26	1,9401	3,971.4	6,376.57	1,6056
Sand.....	4,932.4	1,465.85	9972	4,398.3	2,017.26	4586	3,971.4	2,128.16	5359
Stone.....	4,932.4	3,939.65	8028	4,398.3	2,863.86	6511	3,971.4	3,062.81	7712
Gravel.....	4,932.4	3,176.06	6439	4,398.3	2,645.71	6015	3,971.4	1,284.74	3235
Mixing.....	4,932.4	4,838.16	9809	4,398.3	16,060.09	3,6513	3,971.4	12,852.28	3,2362
Total first division.....	4,932.4	22,372.46	4,5358	4,398.3	46,060.09	11,762.3	3,971.4	11,229.52	6,3721
From construction divisions.....	914.0	5,624.37	6,1536						
Total cost concrete.....	5,846.4	27,996.83	4,7887	4,398.3	16,060.09	3,6513	5,733.7	24,081.80	4,2001
Forms.....	5,846.4	25,112.38	4,2954	4,398.3	19,194.11	4,3641	5,733.7	20,411.60	3,5599
Placing and chipping.....	5,846.4	12,859.00	2,1995	4,398.3	13,753.03	3,1270	5,733.7	12,594.42	2,1966
Reinforcements.....	5,846.4			4,398.3	319.96	0727	5,733.7	262.71	0458
Repairs to equipment.....	5,846.4	947.62	1621	4,398.3	529.29	1203	5,733.7	1,299.49	2266
Division expense.....	5,846.4	2,589.06	4428	4,398.3	2,819.49	6410	5,733.7	2,204.39	3845
Total division cost.....	5,846.4	69,504.89	11,8885	4,398.3	52,675.97	11,9764	5,733.7	60,854.41	10,6135
Administrative and general expense.....	5,846.4	6,963.06	1,1910	4,398.3	4,905.04	1,1153	5,733.7	4,451.26	7763
Total cost.....	5,846.4	76,467.95	13,0795	4,398.3	57,581.01	13,0917	5,733.7	65,305.67	11,3898
Concrete mixed and placed by construction divisions.....	789.0	8,815.99	11,1736						
Total track system and approach walls.....	6,635.4	85,283.94	12,8529	4,398.3	57,581.01	13,0917	5,733.7	65,305.67	11,3898
Total masonry.....	16,706.1	245,700.57	14,7072	10,190.1	135,157.00	13,2637	9,814.39	119,658.39	12,1921

## EXHIBIT C.—DETAILED COST OF WORK DONE BY FIRST AND SECOND DIVISIONS AND ON PERMANENT TOWN SITES AND BUILDINGS, TO JUNE 30, 1913—Continued.

TABLE 3.—*Hydroelectric power house, Gatun—Operating machinery.*

[Detailed cost to June 30, 1913.]

	Amount.
Inspection in the United States.....	\$273.36
Inspection on the Isthmus.....	16.11
Contract payments.....	162,941.48
Installation expenses:	
Surveys.....	1,625.72
Mechanical erection—	
Penstocks.....	18,825.21
Turbines.....	2,051.91
Gatehouse.....	195.10
Draft tubes.....	2,985.89
Air-compressor system.....	16.32
Oil system.....	113.81
Overhead crane.....	40.13
Lighting transformers.....	1.70
Ground busses.....	335.36
Conduits.....	367.76
Lighting fixtures and wiring.....	40.56
Electrical installation—	
Lighting transformers.....	26.40
Ground busses.....	120.21
Testing.....	298.28
Miscellaneous expenses.....	9,974.86
Division expense.....	1,271.74
Total installation expenses.....	38,290.96
Administrative and general expenses.....	7,882.91
Total operating machinery, Gatun powerhouse.....	209,404.82

TABLE 4.—*Electric transmission line.*

[Detailed cost to June 30, 1913.]

	Quantities.	Amount.	Unit cost.
	<i>Cubic yards.</i>		
Inspection in United States.....		\$735.44	
Surveys.....		3,605.67	
Construction cable ducts, Gatun:			
Excavation.....	195	131.66	\$0.6751
Concrete.....	8	52.12	6.5150
Division expense.....		18.56	
Total cable ducts, Gatun.....		202.34	
Foundations for bridges:			
Mile 34.....		1,058.66	
Mile 35.....		2,104.03	
Mile 36.....		5.04	
Division expense.....		542.43	
Total foundations for bridges.....		3,710.16	
Transformer substation, Gatun:			
Excavation.....	1,612	183.34	.1137
Division expense.....	1,612	14.62	.0091
Total transformer substation, Gatun.....		197.96	
Miscellaneous expenses.....		1,675.95	
Material on hand and unapplied.....		3,086.81	
Administrative and general expenses.....		801.30	
Total electric transmission line.....		14,015.63	

## EXHIBIT C.—DETAILED COST OF WORK DONE BY FIRST AND SECOND DIVISIONS AND ON PERMANENT TOWN SITES AND BUILDINGS, TO JUNE 30, 1913—Continued.

TABLE 5.—Lighting and buoying canal, fiscal year 1913.

[Detail cost per unit of work.]

	Quantities.	Amount.	Unit cost.
<b>Preliminary work:</b>	<i>Cubic yards.</i>		
Surveys.....		\$17,131.91	.....
Division expense.....		3,338.80	.....
Total division cost.....		20,470.71	.....
Administrative and general expense.....		3,084.08	.....
Total cost.....		23,554.79	.....
Clearing land.....		24,599.02	.....
Division expense.....		3,804.10	.....
Total division cost.....		28,403.12	.....
Administrative and general expense.....		4,466.35	.....
Total cost.....		32,869.47	.....
Total preliminary work.....		56,424.26	.....
<b>West breakwater light:</b>			
Foundation, concrete caisson.....		10,548.65	.....
Structure, stairway.....		89.81	.....
Handling material.....		1,194.65	.....
Division expense.....		2,522.49	.....
Total division cost.....		14,355.60	.....
Administrative and general expense.....		1,730.11	.....
Total cost.....		16,085.71	.....
<b>Tower 5, Atlantic, 74 feet 10 inches:</b>			
Foundations—			
Excavation.....	26.00	45.06	\$1.7331
Masonry.....	24.7	462.81	18.7369
Structure—			
Masonry.....	65.97	1,760.04	26.6795
Stairway.....		545.13	.....
Metal work.....		603.10	.....
Carpenter work.....		104.96	.....
Illumination.....		6.00	.....
Lantern glass.....		9.03	.....
Handling material.....		806.15	.....
Division expense.....		572.42	.....
Total division cost.....		4,914.70	.....
Administrative and general expense.....		447.38	.....
Total cost.....		5,362.08	.....
<b>Tower 6, Atlantic, 46 feet 4 inches:</b>			
Foundations—			
Excavation.....	19	24.23	1.2752
Masonry.....	14.2	156.52	11.0225
Structure—			
Masonry.....	40.5	919.47	22.7029
Stairway.....		303.33	.....
Metal work.....		671.47	.....
Carpenter work.....		78.38	.....
Illumination.....		13.96	.....
Lantern glass.....		9.03	.....
Handling material.....		344.56	.....
Division expense.....		285.90	.....
Total division cost.....		2,806.85	.....
Administrative and general expense.....		239.98	.....
Total cost.....		3,046.83	.....
<b>Tower 1, lake, 28 feet 10 inches:</b>			
Foundations—			
Excavation.....	400	560.27	1.4007
Masonry.....	77	1,757.59	22.8268
Structure—			
Masonry.....	22.1	862.68	35.6782
Stairway.....		129.61	.....
Metal work.....		609.35	.....
Painting.....		8.13	.....
Carpenter work.....		36.40	.....

## EXHIBIT C.—DETAILED COST OF WORK DONE BY FIRST AND SECOND DIVISIONS AND ON PERMANENT TOWN SITES AND BUILDINGS, TO JUNE 30, 1913—Continued.

TABLE 5.—*Lighting and buoying canal, fiscal year 1913*—Continued.

	Quantities.	Amount.	Unit cost.
<b>Tower 1, lake, 28 feet 10 inches—Continued.</b>	<i>Cubic yards.</i>		
Lantern glass.....		\$43. 17	
Handling material.....		636. 49	
Division expense.....		540. 44	
Total division cost.....		5, 184. 13	
Administrative and general expense.....		365. 64	
Total cost.....		5, 549. 77	
<b>Tower 2, lake, 87 feet 10 inches:</b>			
Surveys and clearing.....		20. 43	
Foundations—			
Excavation.....	612. 4	901. 46	\$1. 4720
Masonry.....	186	2, 655. 16	14. 2569
Structure—			
Masonry.....	87. 96	2, 849. 76	32. 3984
Stairway.....		477. 99	
Metal work.....		642. 71	
Painting.....		23. 22	
Carpenter work.....		187. 21	
Illumination.....		2. 14	
Lantern glass.....		20. 70	
Handling material.....		1, 653. 09	
Division expense.....		1, 816. 67	
Total division cost.....		11, 250. 54	
Administrative and general expense.....		938. 40	
Total cost.....		12, 188. 94	
<b>Tower 3, lake, 30 feet 7 inches:</b>			
Foundations—			
Excavation.....	35	57. 96	1. 6560
Masonry.....	53	681. 45	12. 8575
Structure—			
Masonry.....	10. 92	521. 13	47. 7225
Metal work.....		67. 57	
Painting.....		1. 60	
Carpenter work.....		80. 60	
Lantern glass.....		4. 29	
Handling material.....		717. 02	
Division expense.....		306. 08	
Total division cost.....		2, 437. 70	
Administrative and general expense.....		227. 70	
Total cost.....		2, 665. 40	
<b>Tower 4, lake:</b>			
Structure—			
Metal work.....		67. 57	
Carpenter work.....		80. 61	
Lantern glass.....		4. 29	
Division expense.....		. 77	
Total division cost.....		153. 24	
Administrative and general expense.....		9. 07	
Total cost.....		162. 31	
<b>Tower 5, lake, 30 feet 7 inches:</b>			
Foundations—			
Excavation.....	35	67. 62	1. 9320
Masonry.....	77	1, 813. 85	23. 5564
Structure—			
Masonry.....	10. 92	488. 59	44. 7426
Metal work.....		83. 09	
Painting.....		1. 60	
Carpenter work.....		80. 61	
Lantern glass.....		4. 29	
Handling material.....		2, 310. 73	
Division expense.....		717. 17	
Total division cost.....		5, 567. 55	
Administrative and general expense.....		504. 34	
Total cost.....		6, 071. 89	

## EXHIBIT C.—DETAILED COST OF WORK DONE BY FIRST AND SECOND DIVISIONS AND ON PERMANENT TOWN SITES AND BUILDINGS, TO JUNE 30, 1913—Continued.

TABLE 5.—*Lighting and buoying canal, fiscal year 1913—Continued.*

	Quantities.	Amount.	Unit cost.
<b>Tower 6, lake:</b>			
Structure—	<i>Cubic yards.</i>		
Metal work.....		\$67.55	
Carpenter work.....		80.62	
Lantern glass.....		4.29	
Division expense.....		.77	
Total division cost.....		153.23	
Administrative and general expense.....		9.08	
Total cost.....		162.31	
<b>Tower 7, lake, 30 feet 7 inches:</b>			
Foundations—			
Excavation.....	31.00	47.44	\$1.5303
Masonry.....	10.48	99.21	9.4666
Structure—			
Masonry.....	10.92	648.99	59.4316
Metal work.....		67.57	
Painting.....		1.59	
Carpenter work.....		80.60	
Lantern glass.....		4.29	
Handling material.....		645.13	
Division expense.....		213.31	
Total division cost.....		1,808.13	
Administrative and general expense.....		136.00	
Total cost.....		1,944.13	
<b>Tower 8, lake:</b>			
Surveys and clearing.....		344.73	
Structure—			
Metal work.....		67.57	
Carpenter work.....		80.61	
Lantern glass.....		4.29	
Division expense.....		46.46	
Total division cost.....		543.66	
Administrative and general expense.....		16.75	
Total cost.....		560.41	
<b>Tower 9, lake, 30 feet 7 inches:</b>			
Surveys and clearing.....		2.33	
Foundations—			
Excavation.....	30.00	34.21	1.1403
Masonry.....	10.48	37.17	3.5467
Structure—			
Masonry.....	10.92	615.93	56.4038
Metal work.....		67.55	
Painting.....		1.59	
Carpenter work.....		80.60	
Lantern glass.....		4.28	
Handling material.....		859.91	
Division expense.....		252.03	
Total division cost.....		1,955.60	
Administrative and general expense.....		123.93	
Total cost.....		2,079.53	
<b>Tower 10, lake:</b>			
Surveys and clearing.....		160.52	
Structure—			
Metal work.....		67.55	
Carpenter work.....		80.61	
Lantern glass.....		4.28	
Handling material.....		25.86	
Division expense.....		50.54	
Total division cost.....		389.36	
Administrative and general expense.....		33.89	
Total cost.....		423.25	

## EXHIBIT C.—DETAILED COST OF WORK DONE BY FIRST AND SECOND DIVISIONS AND ON PERMANENT TOWN SITES AND BUILDINGS, TO JUNE 30, 1913—Continued.

TABLE 5.—*Lighting and buoing canal, fiscal year 1913—Continued.*

	Quantities.	Amount.	Unit cost.
<b>Tower 11, lake, 30 feet 7 inches:</b>	<i>Cubic yards.</i>		
Surveys and clearing.....		\$121.61	
Foundations—			
Excavation.....	42.00	124.47	\$2.9636
Masonry.....	79.50	486.52	6.1197
Structure—			
Masonry.....	11.00	360.54	32.7764
Metal work.....		145.74	
Painting.....		1.59	
Carpenter work.....		146.21	
Lantern glass.....		4.28	
Handling material.....		1,992.98	
Division expense.....		878.75	
Total division cost.....		4,262.69	
Administrative and general expense.....		441.32	
Total cost.....		4,704.61	
<b>Tower 12, lake:</b>			
Surveys and clearing.....		390.02	
Foundations—masonry.....		.50	
Structure—			
Masonry.....		22.27	
Metal work.....		68.33	
Painting.....		1.59	
Carpenter work.....		80.60	
Lantern glass.....		4.28	
Handling material.....		20.83	
Division expense.....		98.59	
Total division cost.....		687.01	
Administrative and general expense.....		56.88	
Total cost.....		743.89	
<b>Tower 13, lake:</b>			
Surveys and clearing.....		211.85	
Structure—			
Metal work.....		68.32	
Carpenter work.....		80.61	
Lantern glass.....		4.28	
Division expense.....		27.46	
Total division cost.....		392.52	
Administrative and general expense.....		13.12	
Total cost.....		405.64	
<b>Tower 14, lake:</b>			
Surveys and clearing.....		135.89	
Structure—			
Metal work.....		68.32	
Carpenter work.....		80.60	
Lantern glass.....		4.28	
Division expense.....		36.32	
Total division cost.....		325.41	
Administrative and general expense.....		32.32	
Total cost.....		357.73	
<b>Tower 15, lake, 30 feet 7 inches:</b>			
Surveys and clearing.....		328.72	
Foundations—			
Excavation.....	28.00	37.01	1.3218
Masonry.....	10.50	55.28	5.2648
Structure—			
Masonry.....	11.00	398.98	3.6271
Metal work.....		91.59	
Painting.....		113.61	
Carpenter work.....		101.13	
Lantern glass.....		4.28	
Handling material.....		1,768.24	
Division expense.....		685.24	
Total division cost.....		3,584.08	
Administrative and general expense.....		220.58	
Total cost.....		3,804.66	



## EXHIBIT C.—DETAILED COST OF WORK DONE BY FIRST AND SECOND DIVISIONS AND ON PERMANENT TOWN SITES AND BUILDINGS, TO JUNE 30, 1913—Continued.

TABLE 5.—*Lighting and buoying canal, fiscal year 1913—Continued.*

	Quantities.	Amount.	Unit cost.
<b>Tower 16, lake, 30 feet 7 inches:</b>	<i>Cubic yards.</i>		
Surveys and clearing.....		\$335.59	
Foundations—			
Excavation.....	28	22.09	\$0.7889
Masonry.....	10.5	114.44	10.8990
Structure—			
Masonry.....	11	515.07	46.8245
Metal work.....		69.35	
Painting.....		12.20	
Carpenter work.....		140.48	
Lantern glass.....		4.28	
Handling material.....		1,175.90	
Division expense.....		661.02	
Total division cost.....		3,050.42	
Administrative and general expense.....		254.47	
Total cost.....		3,304.89	
<b>Tower 17, lake, 30 feet 7 inches:</b>			
Surveys and clearing.....		156.42	
Foundations—			
Excavation.....	63	49.80	.7905
Masonry.....	67.5	798.02	11.8225
Structure—			
Masonry.....	11	422.07	38.3700
Metal work.....		91.76	
Painting.....		8.42	
Carpenter work.....		114.27	
Lantern glass.....		4.28	
Handling material.....		2,358.61	
Division expense.....		723.98	
Total division cost.....		4,727.63	
Administrative and general expense.....		349.42	
Total cost.....		5,077.05	
<b>Tower 18, lake, 50 feet 7 inches:</b>			
Surveys and clearing.....		75.44	
Foundations—			
Excavation.....	47	45.52	.9685
Masonry.....	13	158.05	12.1577
Structure—			
Masonry.....	22.5	622.79	27.6796
Metal work.....		85.76	
Painting.....		21.85	
Carpenter work.....		133.15	
Lantern glass.....		4.28	
Handling material.....		1,090.66	
Division expense.....		528.58	
Total division cost.....		2,769.08	
Administrative and general expense.....		276.28	
Total cost.....		3,045.36	
<b>Beacon 19, lake:</b>			
Surveys and clearing.....		19.60	
Division expense.....		4.36	
Total division cost.....		23.96	
Administrative and general expense.....		2.56	
Total cost.....		26.52	
<b>Beacon 20, lake:</b>			
Surveys and clearing.....		19.60	
Division expense.....		4.36	
Total division cost.....		23.96	
Administrative and general expense.....		2.56	
Total cost.....		26.52	

EXHIBIT C.—DETAILED COST OF WORK DONE BY FIRST AND SECOND DIVISIONS AND ON PERMANENT TOWN SITES AND BUILDINGS, TO JUNE 30, 1913—Continued.

TABLE 5.—*Lighting and buoying canal, fiscal year 1913—Continued.*

	Quantities.	Amount.	Unit cost.
<b>Tower 22, lake, 30 feet 7 inches:</b>	<i>Cubic yards.</i>		
Surveys and clearing.....		\$18.56	.....
Foundations—			
Excavation.....	35	37.59	\$1.0740
Masonry.....	10.48	158.35	15.1097
Structure—			
Masonry.....	10.9	644.59	59.1366
Metal work.....		154.35	
Carpenter work.....		82.10	
Lantern glass.....		4.28	
Handling material.....		526.57	
Division expense.....		222.67	
Total division cost.....		1,849.06	
Administrative and general expense.....		167.52	
Total cost.....		2,016.58	
<b>Tower 23, lake:</b>			
Surveys and clearing.....		18.54	
Structure—			
Metal work.....		65.88	
Carpenter work.....		55.11	
Lantern glass.....		4.28	
Division expense.....		7.24	
Total division cost.....		151.05	
Administrative and general expense.....		11.58	
Total cost.....		162.63	
<b>Tower 24, lake, 28 feet 10 inches:</b>			
Surveys and clearing.....		1.03	
Foundations—			
Excavation.....	10	14.51	1.4510
Masonry.....	5.7	113.15	19.8508
Structure—			
Masonry.....	22.1	414.33	18.7479
Stairway.....		134.84	
Metal work.....		761.81	
Painting.....		28.31	
Carpenter work.....		36.56	
Illumination.....		1.93	
Lantern glass.....		9.03	
Handling material.....		99.76	
Division expense.....		191.25	
Total division cost.....		1,806.51	
Administrative and general expense.....		169.24	
Total cost.....		1,975.75	
<b>Tower 25, lake, 46 feet 4 inches:</b>			
Surveys and clearing.....		3.10	
Foundations—			
Excavation.....	35	63.52	1.8149
Masonry.....	14.2	206.49	14.5415
Structure—			
Masonry.....	40.5	1,008.79	24.9085
Stairway.....		247.06	
Metal work.....		719.65	
Painting.....		30.24	
Carpenter work.....		68.26	
Illumination.....		1.93	
Lantern glass.....		9.03	
Handling material.....		686.14	
Division expense.....		427.14	
Total division cost.....		3,471.35	
Administrative and general expense.....		338.51	
Total cost.....		3,809.86	

## EXHIBIT C.—DETAILED COST OF WORK DONE BY FIRST AND SECOND DIVISIONS AND ON PERMANENT TOWN SITES AND BUILDINGS, TO JUNE 30, 1913—Continued.

TABLE 5.—*Lighting and buoys canal, fiscal year 1913—Continued.*

	Quantities.	Amount.	Unit cost.
<b>Tower 27, lake, 42 feet 4 inches:</b>	<i>Cubic yards.</i>		
Surveys and clearing.....		\$38.35	
Foundations—			
Excavation.....	170	295.06	\$1.7356
Masonry.....	14.2	203.29	14.3162
Structure—			
Masonry.....	40.7	810.71	19.9192
Stairway.....		160.43	
Metal work.....		498.69	
Painting.....		3.18	
Carpenter work.....		52.87	
Handling material.....		702.90	
Division expense.....		352.49	
Total division cost.....		3,117.97	
Administrative and general expense.....		185.57	
Total cost.....		3,303.54	
<b>Tower 28, lake:</b>			
Surveys and clearing.....		339.76	
Structure—			
Metal work.....		105.56	
Carpenter work.....		5.97	
Lantern glass.....		4.28	
Handling material.....		22.49	
Division expense.....		60.50	
Total division cost.....		538.56	
Administrative and general expenses.....		39.37	
Total cost.....		577.93	
<b>Beacon, Santa Cruz:</b>			
Surveys and clearing.....		52.57	
Foundations—			
Excavation.....		22.88	
Masonry.....		92.16	
Handling material.....		113.43	
Division expense.....		39.21	
Total division cost.....		320.25	
Administrative and general expense.....		9.72	
Total cost.....		329.97	
<b>Beacon, Bas Obispo:</b>			
Surveys and clearing.....		65.72	
Foundations, masonry.....		4.17	
Division expense.....		18.37	
Total division cost.....		88.26	
Administrative and general expense.....		14.24	
Total cost.....		102.50	
<b>Tower 1, Pacific, 42 feet 4 inches:</b>			
Foundations—			
Excavation.....	81	140.28	1.7319
Masonry.....	110	2,389.24	21.7203
Structure—			
Masonry.....	38.6	990.52	25.6611
Stairway.....		127.12	
Metal work.....		612.12	
Painting.....		19.00	
Carpenter work.....		64.44	
Illumination.....		631.12	
Lantern glass.....		9.03	
Handling material.....		1,415.88	
Division expense.....		736.70	
Total division cost.....		7,135.45	
Administrative and general expense.....		559.29	
Total cost.....		7,694.74	

## EXHIBIT C.—DETAILED COST OF WORK DONE BY FIRST AND SECOND DIVISIONS AND ON PERMANENT TOWN SITES AND BUILDINGS, TO JUNE 30, 1913—Continued.

TABLE 5.—*Lighting and buoying canal, fiscal year 1913*—Continued.

	Quantities.	Amount.	Unit cost.
<b>Tower 2, Pacific, 46 feet 4 inches:</b>			
Foundations—	<i>Cubic yards.</i>		
Excavation.....	28	\$26.40	\$0.9429
Masonry.....	14.2	205.44	14.4676
Structure—			
Masonry.....	40.5	1,037.33	25.6130
Stairway.....		139.43	
Metal work.....		649.62	
Painting.....		26.20	
Carpenter work.....		87.69	
Illumination.....		645.67	
Lantern glass.....		9.03	
Handling material.....		1,208.58	
Division expense.....		468.01	
Total division cost.....		4,503.40	
Administrative and general expense.....		389.01	
Total cost.....		4,892.41	
<b>Tower 3, Pacific, 28 feet 10 inches:</b>			
Foundations—masonry.....	149	2,908.78	19.5220
Structure—			
Masonry.....	21.3	1,002.07	47.0455
Stairway.....		74.36	
Metal work.....		605.76	
Painting.....		64.23	
Carpenter work.....		37.22	
Illumination.....		1,575.12	
Lantern glass.....		9.03	
Handling material.....		960.00	
Division expense.....		612.53	
Total division cost.....		7,858.10	
Administrative and general expense.....		404.46	
Total cost.....		8,262.56	
<b>Tower 4, Pacific, 46 feet 4 inches:</b>			
Foundations—masonry.....	68.2	1,190.48	17.4557
Structure—			
Masonry.....	40.5	1,745.58	43.1007
Stairway.....		139.43	
Metal work.....		642.71	
Painting.....		34.07	
Carpenter work.....		72.08	
Illumination.....		1,575.12	
Lantern glass.....		9.03	
Handling material.....		875.93	
Division expense.....		642.47	
Total division cost.....		6,926.90	
Administrative and general expense.....		449.84	
Total cost.....		7,376.74	
<b>Beacon 5, Pacific:</b>			
Foundations—			
Piles in place.....		264.05	
Masonry.....		196.96	
Structure—			
Steel frame.....		407.43	
Masonry.....		880.09	
Metal work.....		18.03	
Carpenter work.....		31.01	
Illumination.....		4.95	
Handling material.....		302.79	
Division expense.....		308.99	
Total division cost.....		2,414.30	
Administrative and general expense.....		162.69	
Total cost.....		2,576.99	

## EXHIBIT C.—DETAILED COST OF WORK DONE BY FIRST AND SECOND DIVISIONS AND ON PERMANENT TOWN SITES AND BUILDINGS, TO JUNE 30, 1913—Continued.

TABLE 5.—*Lighting and buoying canal, fiscal year 1913—Continued.*

	Quantities.	Amount.	Unit cost.
<b>Beacon 6, Pacific:</b>	<i>Cubic yards.</i>		
Foundations, piles in place.....		\$198.00	
Structure—			
Steel frame.....		277.74	
Masonry.....		140.39	
Metal work.....		9.17	
Handling material.....		3.51	
Division expense.....		7.79	
Total division cost.....		636.60	
Administrative and general expense.....		5.90	
Total cost.....		642.50	
<b>Beacon 7, Pacific:</b>			
Foundations—			
Piles in place.....	10.0	264.06	
Masonry.....		218.70	\$21.8700
Structure—			
Steel frame.....		277.74	
Masonry.....		653.16	
Metal work.....		29.77	
Carpenter work.....		43.58	
Illumination.....		4.95	
Handling material.....		168.79	
Division expense.....		178.74	
Total division cost.....		1,839.49	
Administrative and general expense.....		120.34	
Total cost.....		1,959.83	
<b>Beacon 8, Pacific:</b>			
Foundations—			
Piles in place.....		309.79	
Masonry.....		138.09	
Structure—			
Steel frame.....		277.74	
Masonry.....		660.75	
Metal work.....		23.70	
Carpenter work.....		21.26	
Illumination.....		1.13	
Handling material.....		172.19	
Division expense.....		161.20	
Total division cost.....		1,765.85	
Administrative and general expense.....		110.46	
Total cost.....		1,876.31	
<b>Beacon 9, Pacific:</b>			
Foundations, piles in place.....		198.00	
Structure—			
Steel frame.....		277.74	
Masonry.....		140.86	
Metal work.....		9.16	
Handling material.....		3.50	
Division expense.....		7.79	
Total division cost.....		637.05	
Administrative and general expense.....		5.90	
Total cost.....		642.95	
<b>Beacon 10, Pacific, foundations, piles in place.....</b>		198.00	
<b>Tower 12, Pacific, 28 feet 10 inches:</b>			
Foundations, masonry.....	5.7	148.32	26.0210
Structure—			
Masonry.....	22.1	698.26	31.5955
Stairway.....		114.00	
Metal work.....		639.14	
Carpenter work.....		46.92	
Lantern glass.....		17.53	
Handling material.....		178.89	
Division expense.....		286.08	
Total division cost.....		2,129.14	
Administrative and general expense.....		219.35	
Total cost.....		2,348.49	

## EXHIBIT C.—DETAILED COST OF WORK DONE BY FIRST AND SECOND DIVISIONS AND ON PERMANENT TOWN SITES AND BUILDINGS, TO JUNE 30, 1913—Continued.

TABLE 5.—*Lighting and buoying canal, fiscal year 1913—Continued.*

	Quantities.	Amount.	Unit cost.
Tower 13, Pacific, 28 feet 10 inches:	<i>Cubic yards.</i>		
Foundations, masonry.....	5.7	\$57.66	\$10.1157
Structure—			
Masonry.....	22.1	451.42	20.0190
Stairway.....		74.36	
Metal work.....		596.04	
Carpenter work.....		37.61	
Lantern glass.....		9.03	
Handling material.....		466.70	
Division expense.....		194.80	
Total division cost.....		1,887.62	
Administrative and general expense.....		184.63	
Total cost.....		2,072.25	
Reference targets:	<i>Number.</i>		
Pena Blanca, P. I.....	1	243.29	243.2900
Bohio—			
North.....	2	429.80	214.9000
P. I.....	1	322.82	322.8200
South.....	2	394.62	197.3100
Buenavista.....	1	97.45	97.4500
Frijoles, P. I.....	1	147.05	147.0500
Tabernilla.....	1	603.14	603.1400
San Pablo—			
North.....	1	379.98	379.9800
Middle.....	1	168.17	168.1700
South.....	1	260.64	260.6400
Caimito.....	2	362.17	181.0850
Mamei—			
West.....	2	285.97	142.9850
East.....	2	786.20	393.1000
Juan Grande.....	2	654.53	327.2650
Santa Cruz.....	2	116.47	58.2350
Bas Obispo—			
North.....	2	50.51	25.2550
South.....	2	261.86	130.9300
Division expense.....		1,134.02	
Total division cost.....		6,698.69	
Administrative and general expense.....		599.72	
Total cost.....		7,298.41	
Transmission lines:	<i>Linear feet.</i>		
Pacific entrance, west—			
Poles in place.....	15,600	1,537.16	.0985
Insulators and wires.....	15,600	1,294.70	.0830
Handling material.....	15,600	178.19	.0114
Division expense.....	15,600	473.49	.0304
Total division cost.....	15,600	3,483.54	.2233
Administrative and general expense.....	15,600	306.57	.0197
Total cost.....	15,600	3,790.11	.2430
Bas Obispo conduit—			
Surveys and clearing.....		90.22	
Handling material.....		9.38	
Division expense.....		15.61	
Total division cost.....		115.21	
Administrative and general expense.....		3.19	
Total cost.....		118.40	
To tower 28, lake—			
Poles in place.....		213.66	
Handling material.....		7.43	
Total division cost.....		221.09	
To towers 12 and 13, Pacific, insulators and wires in place.....		100.22	

## EXHIBIT C.—DETAILED COST OF WORK DONE BY FIRST AND SECOND DIVISIONS AND ON PERMANENT TOWN SITES AND BUILDINGS, TO JUNE 30, 1913—Continued.

TABLE 5.—*Lighting and buoying canal, fiscal year 1913—Continued.*

	Quantities.	Amount.	Unit cost.
	<i>Number.</i>		
Gas buoys, Pacific entrance:			
Unloading upon delivery.....	6	\$90.63	\$15.1050
Assembling.....	6	211.54	35.2567
Painting.....	6	53.24	8.8733
Assembling chain.....	6	59.45	9.9083
Sinkers.....	6	98.00	16.3333
Chains.....	6	662.87	110.4783
Placing on station.....	6	496.75	82.7917
Contract payments.....	6	17,370.00	2,895.0000
Division expense.....	6	205.63	34.2717
Total division cost.....	6	19,248.11	3,208.0183
Administrative and general expense.....	6	1,878.96	313.1600
Total cost.....	6	21,127.07	3,521.1783
Gas buoys, Porto Bello: Placing on station.....	1	275.00	275.0000
Miscellaneous expenses:			
Lighting ranges and beacons—			
Pacific entrance.....		1,127.29	
Atlantic entrance.....		546.96	
Illumination—experimental.....		1,057.82	
Total miscellaneous.....		2,732.07	
Material on hand and unapplied.....		147,776.49	
Total construction expenditures.....		370,485.08	

TABLE 6.—*Cristobal terminals.*

[Detailed cost to June 30, 1913.]

	Amount.
Coaling plant:	
Designing.....	\$439.89
Dredging—	
Clearing site.....	474.28
Blasting.....	474.79
Division expense.....	35.59
Total.....	984.66
Total coaling plant.....	1,424.55
Fuel-oil tanks:	
Inspection on Isthmus.....	621.06
Land damages.....	2,415.00
Roadways.....	3,765.70
Foundations.....	4,505.85
Painting.....	201.34
Pipe lines.....	1,452.64
Division expense.....	102.00
Total fuel-oil tanks.....	13,063.59
Total Cristobal terminals.....	14,488.14

## EXHIBIT C.—DETAILED COST OF WORK DONE BY FIRST AND SECOND DIVISIONS AND ON PERMANENT TOWN SITES AND BUILDINGS, TO JUNE 30, 1913—Continued.

TABLE 7.—Terminal facilities Balboa, fiscal year 1913.

[Detail cost per unit of work.]

	Quantities.	Amount.	Unit cost.
<b>Preliminary and general work:</b>	<i>Cubic yards.</i>		
Surveys.....		\$22,028.77	
Clearing site.....		6,992.90	
Boring and test pits.....		<b>2,296.91</b>	
Division expense.....		1,703.93	
Total division cost.....		28,428.69	
Administrative and general expense.....		3,848.59	
Total cost.....		<b>32,277.28</b>	
<b>Preparing sites, general:</b>			
Miscellaneous work—			
Removal of buildings.....		60,955.17	
Removal of landing stage for Union Oil Co.....		10,615.05	
Removal and rearrangement of Panama R. R. tracks.....		56,435.10	
General tracks.....		2,418.57	
Removal and reconstruction Balboa-Ancon road.....		5,142.57	
Removal and construction of water mains.....		11,725.46	
Concrete drain ditch, Sosa Hill.....	368	5,003.12	\$13.5954
Removal of quartermaster's material yard.....		4,944.95	
Line to Diablo Hill.....		7,772.03	
Division expense.....		2,615.24	
Total division cost.....		167,627.26	
Administrative and general expense.....		9,397.51	
Total cost.....		<b>177,024.77</b>	
<b>Excavation—</b>			
Clearing.....	412,707	51.61	.0001
Drilling.....	412,707	31,541.65	.0764
Blasting.....	412,707	35,672.20	.0864
Excavation by steam shovel.....	395,198	30,418.09	.0770
Excavation by hand.....	17,509	4,338.80	.2478
Tracks.....	412,707	31,788.94	.0770
Transportation.....	412,707	14,694.74	.0355
Dumps.....	412,707	8,481.59	.0206
Drainage.....	412,707	2,340.43	.0057
Maintenance of equipment.....	412,707	23,815.19	.0577
Plant arbitrary.....	412,707	39,241.52	.0952
Division expense.....	412,707	9,572.81	.0232
Total division cost.....	412,707	231,957.57	.5620
Administrative and general expense.....	412,707	17,241.92	.0418
Total cost.....	412,707	<b>249,199.49</b>	.6038
<b>Filling—</b>			
Transportation.....	505,419	23,125.81	.0458
Trestles.....	505,419	2,459.07	.0049
Tracks.....	505,419	72,439.88	.1433
Filling and grading.....	505,419	47,034.77	.0931
Maintenance of equipment.....	505,419	12,679.52	.0251
Plant arbitrary.....	505,419	37,960.48	.0750
Division expense.....	505,419	6,064.54	.0120
Total division cost.....	505,419	201,764.07	.3992
Administrative and general expense.....	505,419	13,034.34	.0258
Total cost.....	505,419	<b>214,798.41</b>	.4250
<b>Yards and tracks—</b>			
Filling.....	23,283	5,620.64	.2414
Installation.....		8,691.15	
Division expense.....		739.82	
Total division cost.....		15,051.61	
Administrative and general expense.....		1,392.21	
Total cost.....		<b>16,443.82</b>	
Total preparing site, general.....		<b>657,466.49</b>	



## EXHIBIT C.—DETAILED COST OF WORK DONE BY FIRST AND SECOND DIVISIONS AND ON PERMANENT TOWN SITES AND BUILDINGS, TO JUNE 30, 1913—Continued.

TABLE 7.—Terminal facilities Balboa, fiscal year 1913—Continued.

	Quantities.	Amount.	Unit cost.
<b>Dredging inner basin:</b>			
<b>Dredging harbor—</b>	<i>Cubic yards.</i>		
Clearing.....	1, 771, 814	\$2, 672. 98	\$0. 0015
Operation seagoing suction dredge.....	59, 463	2, 115. 99	.0356
Repairs seagoing suction dredge.....	59, 463	621. 99	.0105
Operation small ladder dredge.....	605, 952	20, 981. 75	.0346
Repairs small ladder dredge.....	605, 952	10, 517. 54	.0174
Operation large ladder dredge.....	10, 000	1, 166. 71	.1167
Repairs large ladder dredge.....	10, 000	853. 11	.0853
Operation dipper dredge.....	15, 699	2, 179. 79	.1388
Repairs dipper dredge.....	15, 699	1, 072. 43	.0683
Operation pipe-line dredge.....	1, 080, 700	47, 858. 54	.0443
Repairs pipe-line dredge.....	1, 080, 700	26, 808. 50	.0248
Dikes.....	1, 080, 700	700. 54	.0006
Pipe lines.....	1, 080, 700	10, 513. 86	.0097
Ditching.....	1, 080, 700	1, 974. 95	.0018
Operation tugs, claps, and scows.....	631, 651	39, 469. 40	.0625
Repairs tugs, claps, and scows.....	631, 651	15, 250. 51	.0241
Small boats.....	1, 771, 814	7, 502. 26	.0042
Repairs miscellaneous equipment.....	1, 771, 814	9, 753. 83	.0055
Plant arbitrary.....	1, 771, 814	18, 650. 93	.0105
Division expense.....	1, 771, 814	6, 493. 66	.0037
Total division cost.....	1, 771, 814	227, 159. 27	.1282
Administrative and general expense.....	1, 771, 814	21, 622. 88	.0122
Total cost.....	1, 771, 814	248, 782. 15	.1404
<b>Reclaiming land—</b>			
Clearing.....	1, 080, 700	425. 13	.0004
Operation relay pumps.....	1, 080, 700	23, 593. 84	.0218
Repairs relay pumps.....	1, 080, 700	2, 441. 98	.0023
Pipe lines.....	1, 080, 700	6, 096. 90	.0056
Dikes.....	1, 080, 700	12, 276. 00	.0114
Plant arbitrary.....	1, 080, 700	1, 391. 09	.0013
Division expense.....	1, 080, 700	732. 71	.0007
Total division cost.....	1, 080, 700	46, 957. 65	.0435
Administrative and general expense.....	1, 080, 700	3, 859. 18	.0035
Total cost.....	1, 080, 700	50, 816. 83	.0470
Total cost dredging.....	1, 771, 814	299, 598. 98	.1691
<b>Main dry dock:</b>			
<b>Preliminary work—</b>			
Clearing.....		548. 40	.....
Surveys.....		233. 56	.....
Boring and test pits.....		10, 652. 94	.....
Designing.....		7, 502. 98	.....
Testing material.....		59. 53	.....
Granite from Cocori Island.....		12. 71	.....
Division expense.....		650. 15	.....
Total division cost.....		19, 660. 27	.....
Administrative and general expense.....		1, 198. 02	.....
Total cost.....		20, 858. 29	.....
<b>Dry excavation—</b>			
Clearing.....	145, 478	9, 437. 24	.0649
Drilling.....	145, 478	27, 563. 97	.1894
Blasting.....	145, 478	12, 196. 44	.0838
Excavation by steam shovel.....	145, 478	11, 505. 24	.0791
Excavation by hand.....	145, 478	1. 87	.....
Tracks.....	145, 478	18, 195. 35	.1251
Transportation.....	145, 478	6, 729. 01	.0463
Dumps.....	145, 478	103. 61	.0007
Drainage.....	145, 478	6, 209. 16	.0427
Maintenance of equipment.....	145, 478	13, 197. 99	.0907
Plant arbitrary.....	145, 478	16, 190. 10	.1113
Division expense.....	145, 478	1, 757. 97	.0121
Total division cost.....	145, 478	123, 087. 95	.8461
Administrative and general expense.....	145, 478	7, 049. 93	.0485
Total cost.....	145, 478	130, 137. 88	.8946

## EXHIBIT C.—DETAILED COST OF WORK DONE BY FIRST AND SECOND DIVISIONS AND ON PERMANENT TOWN SITES AND BUILDINGS, TO JUNE 30, 1913—Continued.

TABLE 7.—Terminal facilities Balboa, fiscal year 1913—Continued.

	Quantities.	Amount.	Unit cost.
Main dry dock—Continued.			
Gates—	<i>Cubic yards.</i>		
Recess covers.....		\$751.05	
Division expense.....		5.20	
Total division cost.....		756.25	
Administrative and general expense.....		97.01	
Total cost.....		853.26	
Total main dry dock.....		151,849.43	
Coaling plant:			
Preliminary work—			
Clearing.....		82.25	
Surveys.....		.32	
Boring and test pits.....		1,596.94	
Designing.....		476.50	
Division expense.....		116.74	
Total division cost.....		2,272.75	
Administrative and general expense.....		182.55	
Total.....		2,455.30	
Dry excavation—			
Clearing.....	58,221	3,776.83	\$0.0649
Drilling.....	58,221	11,031.24	.1894
Blasting.....	58,221	4,881.09	.0838
Excavation by steam shovel.....	58,221	4,604.45	.0791
Excavation by hand.....	58,221	.76	
Tracks.....	58,221	7,281.87	.1251
Transportation.....	58,221	2,692.97	.0463
Dumps.....	58,221	41.46	.0007
Drainage.....	58,221	2,484.93	.0427
Maintenance of equipment.....	58,221	5,281.89	.0907
Plant arbitrary.....	58,221	6,479.36	.1113
Division expense.....	58,221	703.55	.0121
Total division cost.....	58,221	49,260.40	.8461
Administrative and general expense.....	58,221	2,821.42	.0485
Total cost.....	58,221	52,081.82	.8946
Total coaling plant.....		51,537.12	
Sea wall:			
Preliminary work—			
Surveys.....		2.66	
Division expense.....		.07	
Total division cost.....		2.73	
Administrative and general expense.....		.26	
Total cost.....		2.99	
Permanent shops:			
Preliminary work—			
Clearing.....		7,800.16	
Surveys.....		4,857.63	
Boring and test pits.....		660.75	
Designing, general.....		15,560.85	
Motorizing machines, designing.....		1,176.51	
Filling and grading site.....		224.98	
Construction tracks.....		2,194.42	
Inspection in the United States.....		6,644.54	
Inspection on the Isthmus.....		685.31	
Division expense.....		596.98	
Total division cost.....		40,402.13	
Administrative and general expense.....		1,565.92	
Total cost.....		41,968.05	

## EXHIBIT C.—DETAILED COST OF WORK DONE BY FIRST AND SECOND DIVISIONS AND ON PERMANENT TOWN SITES AND BUILDINGS, TO JUNE 30, 1913—Continued.

TABLE 7.—Terminal facilities Balboa, fiscal year 1913—Continued.

	Quantities.	Amount.	Unit cost.
Permanent shops—Continued.			
Foundations—			
Excavation—	<i>Cubic yards.</i>		
Clearing.....	29,684	\$5,598.71	\$0.1886
Blasting.....	29,684	2.99	.0001
Excavation.....	29,684	26,674.43	.8986
Tracks.....	29,684	1,076.24	.0363
Transportation.....	29,684	484.55	.0163
Drainage.....	29,684	684.69	.0231
Cribbing.....	29,684	6,101.46	.2055
Maintenance of equipment.....	29,684	1,134.78	.0382
Plant arbitrary.....	29,684	3,279.58	.1105
Division expense.....	29,684	1,289.98	.0435
Total division cost.....	29,684	46,327.41	1.5607
Administrative and general expense.....	29,684	4,862.25	.1638
Total cost.....	29,684	51,189.66	1.7245
Concrete—			
Cement.....	7,787	14,654.47	1.8819
Stone.....	7,787	6,492.33	.8337
Sand.....	7,787	3,176.29	.4079
Mixing.....	7,787	7,172.03	.9210
Forms.....	7,787	14,867.87	1.9093
Placing.....	7,787	7,081.47	.9094
Reinforcements.....	7,787	5,196.92	.6674
Iron in place.....	7,787	6,414.01	.8237
Pumps.....	7,787	3,317.41	.4260
Maintenance of equipment.....	7,787	490.33	.0630
Plant arbitrary.....	7,787	1,807.31	.2321
Division expense.....	7,787	1,040.80	.1337
Total division cost.....	7,787	71,711.24	9.2091
Administrative and general expense.....	7,787	6,829.40	.8770
Total cost.....	7,787	78,540.64	10.0861
Wood piles—	<i>Linear feet.</i>		
Wood piles in place.....	135,442	64,212.99	.4741
Division expense.....	135,442	1,066.79	.0079
Total division cost.....	135,442	65,279.78	.4820
Administrative and general expense.....	135,442	8,559.43	.0632
Total cost.....	135,442	73,839.21	.5452
Concrete piles—			
Concrete piles in place.....	3,060	9,833.86	3.2137
Division expense.....	3,060	67.67	.0221
Total division cost.....	3,060	9,901.53	3.2358
Administrative and general expense.....	3,060	226.21	.0739
Total cost.....	3,060	10,127.74	3.3097
4-foot caissons—			
Clearing.....		667.03	
Excavation.....	<i>Cubic yards.</i>		
Tracks.....	242	1,497.71	6.1889
Pumps.....		387.87	
		589.97	
Steel cylinders in place.....	<i>Linear feet.</i>		
Plant arbitrary.....	315	1,470.77	4.6691
Division expense.....		11.55	
		76.55	
Total division cost.....	315	4,701.45	14.9252
Administrative and general expense.....	315	170.03	.5398
Total cost.....	315	4,871.48	15.4650
3-foot caissons—			
Iron in place.....		420.51	
Division expense.....		1.57	
Total division cost.....		422.08	

## EXHIBIT C.—DETAILED COST OF WORK DONE BY FIRST AND SECOND DIVISIONS AND ON PERMANENT TOWN SITES AND BUILDINGS, TO JUNE 30, 1913—Continued.

TABLE 7.—Terminal facilities Balboa, fiscal year 1913—Continued.

	Quantities.	Amount.	Unit cost.
Permanent shops—Continued.			
Foundations—Continued.			
9-inch steel tubing—			
Tubing in place.....		\$108.15	
Division expense.....		.41	
Total division cost.....		108.56	
Backfilling—	<i>Cubic yards.</i>		
Backfill.....	4,338	2,937.56	\$0.6771
Plant arbitrary.....	4,338	295.26	.0681
Division expense.....	4,338	72.34	.0167
Total division cost.....	4,338	3,305.16	.7619
Administrative and general expense.....	4,338	94.89	.0219
Total cost.....	4,338	3,400.05	.7838
Total foundations.....		222,499.42	
Floors—			
Grading.....	250	3,722.41	14.8896
Concrete.....	110	946.78	8.6071
Plant arbitrary.....		25.30	
Division expense.....		87.20	
Total division cost.....		4,781.69	
Steel erection—			
Contract payments.....		9,684.56	
Inspection.....		180.14	
Material furnished contractors.....		660.72	
Erection tracks.....		3,949.23	
Transportation.....		1,088.85	
Air and water service.....		25.10	
Division expense.....		118.26	
Total division cost.....		15,706.86	
Administrative and general expense.....		1,357.98	
Total cost.....		17,064.84	
Roofs—			
Roofing.....		442.85	
Division expense.....		5.40	
Total division cost.....		448.25	
Superstructure—			
Wood forms in place.....		411.12	
Mixing.....		12.91	
Placing.....		105.66	
Wire mesh in place.....		845.92	
Tile in place.....		113.72	
Division expense.....		22.22	
Total division cost.....		1,511.55	
Machinery installation—			
Foundations—			
Excavation.....	3,685	2,325.11	.6310
Concrete.....	197	2,487.23	12.6255
Irons in place.....		115.16	
Miscellaneous.....		444.68	
Division expense.....		95.37	
Total division cost.....		5,467.55	
Administrative and general expense.....		332.59	
Total cost.....		5,800.14	
Miscellaneous—			
Motorizing machines.....		883.13	
Sand bins.....		939.25	
Weatherproofing—shop tunnel.....		790.29	
Electric conduit—shop tunnel.....		2,115.18	
Rock fill—shop tunnel.....		397.61	
Division expense.....		51.35	
Total division cost.....		5,176.81	
Administrative and general expense.....		276.62	
Total cost.....		5,453.43	
Total permanent shops.....		299,527.37	

## EXHIBIT C.—DETAILED COST OF WORK DONE BY FIRST AND SECOND DIVISIONS AND ON PERMANENT TOWN SITES AND BUILDINGS, TO JUNE 30, 1913—Continued.

TABLE 7.—Terminal facilities Balboa, fiscal year 1913—Continued.

	Quantities.	Amount.	Unit cost.
<b>Docks:</b>			
Preliminary work—			
Clearing.....		\$68.41	
Surveys.....		730.27	
Boring and test pits.....		3,591.84	
Dikes.....		8,960.32	
Designing.....		935.65	
Construction tracks.....		14,054.50	
Division expense.....		772.78	
Total division cost.....		29,113.77	
Administrative and general expense.....		2,240.68	
Total cost.....		31,354.45	
<b>Excavation for piers—</b>	<b>Cubic yards.</b>		
Clearing.....	28,834	354.99	\$0.0123
Drilling.....	28,834	1.60	.0001
Blasting.....	28,834	13.82	.0005
Excavation by steam shovel.....	20,480	937.09	.0458
Excavation by hand.....	8,354	40,054.49	4.7946
Transportation.....	28,834	1,284.86	.0446
Dumps.....	28,834	1.04	
Drainage.....	28,834	20,805.14	.7215
Maintenance of equipment.....	28,834	11,207.76	.3887
Plant arbitrary.....	28,834	3,100.30	.1075
Division expense.....	28,834	2,046.27	.0710
Total division cost.....	28,834	79,807.36	2.7678
Administrative and general expense.....	28,834	6,386.41	.2215
Total cost.....	28,834	86,193.77	2.9893
<b>Concrete masonry, piers—</b>			
Construction of caisson shells—			
Cement.....	9,446	25,936.31	2.7457
Stone.....	9,446	7,393.11	.7827
Sand.....	9,446	3,651.47	.3866
Mixing.....	9,446	7,201.83	.7624
Wood forms.....	9,446	4,309.67	.4562
Steel forms.....	9,446	8,829.35	.9347
Placing concrete in shell.....	9,446	2,166.75	.2294
Placing shell in place.....	9,446	18,817.99	1.9922
Cutting caissons to grade.....	9,446	267.51	.0283
Reinforcement.....	9,446	24,231.21	2.5652
Pumps.....	9,446	437.06	.0463
Maintenance of equipment.....	9,446	4,871.27	.5157
Plant arbitrary.....	9,446	2,199.17	.2328
Steel shoes in place.....	9,446	9,259.05	.9802
Division expense.....	9,446	1,553.06	.1644
Total division cost.....	9,446	121,124.81	12.8228
Administrative and general expense.....	9,446	10,855.85	1.1493
Total cost.....	9,446	131,980.66	13.9721
<b>Filling in caissons—</b>			
Cement.....	3,914	6,298.56	1.6092
Stone.....	3,914	3,604.62	.9210
Sand.....	3,914	1,608.70	.4110
Mixing.....	3,914	2,195.09	.5608
Steel forms in place.....	3,914	1,787.59	.4567
Placing.....	3,914	1,626.88	.4157
Reinforcement in place.....	3,914	8,134.33	2.0783
Pumps.....	3,914	2,033.89	.5196
Maintenance of equipment.....	3,914	266.13	.0680
Plant arbitrary.....	3,914	900.22	.2300
Division expense.....	3,914	296.53	.0758
Total division cost.....	3,914	28,752.54	7.3461
Administrative and general expense.....	3,914	2,173.56	.5553
Total cost.....	3,914	30,926.10	7.9014

EXHIBIT C.—DETAILED COST OF WORK DONE BY FIRST AND SECOND DIVISIONS AND ON PERMANENT TOWN SITES AND BUILDINGS, TO JUNE 30, 1913—Continued.

TABLE 7.—Terminal facilities Balboa, fiscal year 1913—Continued.

	Quantities.	Amount.	Unit cost.
Docks—Continued.			
Floor system—			
Wood forms in place.....		\$5,382.93	
Placing.....		1,383.25	
Reinforcement.....		20,926.34	
Excavation for girders.....		1,737.96	
Anchoring quay wall.....		689.27	
Division expense.....		260.16	
Total division cost.....		30,379.91	
Administrative and general expense.....		4,053.47	
Total cost.....		34,433.38	
Miscellaneous—			
Snubbing posts.....		65.84	
Permanent tracks.....		1,904.00	
Division expense.....		7.42	
Total division cost.....		1,977.26	
Total docks.....		316,865.62	
Permanent oil tanks and pipe lines:			
Tracks.....		51.59	
Concrete foundations.....		1,881.05	
Tanks.....		147.99	
Pipe lines.....		583.98	
Maintenance of equipment.....		3.08	
Division expense.....		8.49	
Total division cost.....		2,676.18	
Administrative and general expense.....		24.41	
Total cost.....		2,700.59	
Total terminal facilities Balboa.....		1,814,825.87	

TABLE 8.—Permanent town sites

[Detailed cost to June 30, 1913.]

	Amount.
Balboa:	
Surveys.....	\$1,997.94
Clearing.....	198.58
Filling and grading.....	11,010.36
Sewers.....	21,737.77
Drainage.....	1,344.02
Paving.....	8,559.93
Temporary buildings.....	173.43
Division expense.....	785.52
Total division cost.....	45,807.55
Administrative and general expense.....	3,535.70
Total.....	49,343.25
La Boca:	
Surveys.....	220.00
Filling and grading.....	2,406.73
Water works.....	3,386.78
Sewers.....	569.60
Division expense.....	68.11
Total division cost.....	6,651.22
Total permanent town sites.....	55,994.47

## EXHIBIT C.—DETAILED COST OF WORK DONE BY FIRST AND SECOND DIVISIONS AND ON PERMANENT TOWN SITES AND BUILDINGS, TO JUNE 30, 1913—Continued.

TABLE 9.—*Permanent buildings.*

[Detailed cost to June 30, 1913.]

	Quantities.	Amount.	Unit cost.
	<i>Cubic yards.</i>		
Designing, general.....		\$20,278.84	
Administration building:			
Preliminary work—			
Surveys.....		963.85	
Designing.....		166.67	
Division expense.....		78.44	
Total division cost.....		1,208.96	
Administrative and general expense.....		37.25	
Total.....		1,246.21	
Foundations—			
Excavation—			
Clearing.....	38,073	103.41	\$0.0027
Drilling.....	38,073	619.95	.0163
Blasting.....	38,073	137.46	.0036
Excavation by power.....	36,516	4,652.43	.1274
Excavation by hand.....	1,557	2,419.58	1.5540
Tracks.....	38,073	8,811.91	.2314
Transportation.....	38,073	1,586.26	.0417
Dumps.....	38,073	481.14	.0126
Pumps.....	38,073	574.24	.0161
Maintenance of equipment.....	38,073	1,096.17	.0288
Division expense.....	38,073	1,043.58	.0274
Total division cost.....	38,073	21,526.13	.5654
Administrative and general expense.....	38,073	1,043.11	.0274
Total.....	38,073	22,569.24	.5928
Masonry—			
Cement.....	770	1,120.96	1.4558
Stone.....	770	706.06	.9170
Sand.....	770	353.34	.4589
Mixing.....	770	1,443.40	1.8745
Forms.....	770	3,973.80	5.1607
Placing.....	770	1,839.70	2.3892
Division expense.....	770	468.53	.6085
Total division cost.....	770	9,905.79	12.8646
Administrative and general expense.....	770	238.95	.3103
Total.....	770	10,144.74	13.1749
Steel erection—			
Freight and handling.....		474.14	
Division expense.....		28.26	
Total division cost.....		502.40	
Total administration building.....		34,462.59	
Laborers' quarters, La Boca, buildings reerected.....		2,496.64	
Total permanent buildings.....		57,238.07	

## EXHIBIT D.—PERFORMANCE OF CRUSHED STONE, SAND, AND CONCRETE PRODUCING AND HANDLING PLANTS, FISCAL YEAR 1913.

TABLE 1.—Performance of construction plant mixers—Gatun, fiscal year ended June 30, 1913.

[Plant consists of a battery of eight 2-cubic yard mixers.]

## ATLANTIC DIVISION.

Month.	Average number of mixers operated.	Concrete mixed.	Mixing.	Delays.				Total unit hours operated per month.	Average concrete mixed.		Per cent of hours mixing to hours operated.
				Repairs.	Waiting for cars.	Other delays.	Total delays.		Per hour mixing.	Per hour operated.	
		<i>Cu. yds.</i>	<i>Hours.</i>	<i>Hours.</i>	<i>Hours.</i>	<i>Hours.</i>	<i>Hours.</i>		<i>Cu. yds.</i>	<i>Cu. yds.</i>	
July.....	1.80	8,066	139.40	.....	280.83	.....	280.83	420.23	57.86	19.19	33.17
August.....	2.67	6,966	117.20	.....	438.19	.....	438.19	555.39	59.44	12.54	21.10
September.....	1.96	3,158	52.30	.....	324.10	.....	324.10	376.40	60.38	8.39	13.89
October.....	1.81	2,988	49.97	.....	358.46	.....	358.46	406.93	59.99	7.34	12.23
November.....	2.00	5,500	91.64	.....	314.65	.....	314.65	406.93	60.02	13.54	22.55
December.....	2.00	5,811	96.83	.....	340.97	.....	340.97	437.80	60.01	13.27	22.12
January.....	3.46	29,324	488.72	.....	316.45	.....	316.45	863.17	60.00	36.42	60.70
February.....	4.00	30,770	511.84	.....	289.51	.....	289.51	801.35	60.12	38.40	63.87
March.....	3.92	34,736	579.39	.....	291.07	.....	291.07	870.46	59.95	39.91	66.96
April.....	2.54	20,984	346.29	.....	253.25	.....	253.25	599.54	60.60	35.00	57.75
May.....	2.00	12,216	203.62	.....	237.76	.....	237.76	441.38	59.99	27.68	46.13
June.....	2.00	5,310	88.71	.....	311.79	.....	311.79	400.50	59.86	13.26	22.15
Total.....	2.50	165,839	2,765.91	.....	3,757.03	.....	3,757.03	6,522.94	59.95	25.42	42.40
Per cent of total.....	.....	.....	42.40	.....	57.60	.....	57.60	100.00	.....	.....	.....

Plant worked 9 hours per day throughout the year. Quantities shown are bucket measurement.



TABLE 2.—Performance of locks cableway towers—Gatun, fiscal year ended June 30, 1913.

[Plant consists of four duplex cableway towers.]

## ATLANTIC DIVISION.

Month.	Average number of cables operated.	Concrete handled.	Working.		Delays.				Total unit hours operated.	Average concrete handled per cable per hour working.	Per cent of hours working to hours operated.
			Handling concrete.	Handling steel forms, filling, etc.	Total.	Repairing.	Waiting on concrete.	Waiting on forms.	Moving towers.	Total delays.	
		<i>Cu. yds.</i>	<i>Hours.</i>	<i>Hours.</i>	<i>Hours.</i>	<i>Hours.</i>	<i>Hours.</i>	<i>Hours.</i>	<i>Hours.</i>	<i>Hours.</i>	<i>Cu. yds.</i>
July.....	8.00	5,060	234.09	468.48	702.57	18.81	151.71	844.78	119.78	1,135.11	1,837.68
August.....	8.00	3,612	152.17	596.61	748.78	13.72	83.01	350.00	113.28	1,162.01	1,910.79
September.....	8.00	2,278	101.02	483.13	584.15	23.27	32.80	971.53	87.29	1,114.89	1,690.04
October.....	8.00	2,908	145.48	366.31	511.79	16.29	62.82	1,218.03	99.06	1,396.20	1,907.99
November.....	8.00	5,550	189.18	328.53	517.71	13.34	43.55	1,937.49	88.12	1,142.50	1,660.21
December.....	8.00	5,584	204.68	284.62	489.30	36.08	19.05	1,315.73	1,306.79	2,622.49	1,796.09
January.....	8.00	29,284	993.16	337.86	1,331.02	61.37	72.94	315.53	74.76	524.60	1,905.62
February.....	8.00	30,596	1,068.74	152.54	1,221.28	21.35	77.51	279.48	58.48	436.82	1,658.10
March.....	8.00	34,736	1,167.75	135.58	1,303.33	13.04	69.96	338.93	77.23	499.16	1,800.49
April.....	8.00	20,484	698.55	514.79	1,213.34	20.28	20.33	566.96	87.29	694.86	1,908.00
May.....	8.00	12,240	406.38	566.18	972.56	17.11	13.12	839.28	95.90	724.44	1,697.00
June.....	6.00	5,310	109.15	456.06	625.21	8.32	7.24	839.28	119.95	974.79	1,600.00
Total.....	7.83	158,262	5,530.15	4,738.69	10,268.84	262.98	656.07	9,084.05	1,109.07	11,112.17	21,381.01
Per cent of total.....			25.86	22.17	48.03	1.23	3.06	42.49	5.19	51.97	100.00

Four towers were operated 9 hours per day from July 1 to Dec. 29, and from Feb. 2 to May 23; one tower was operated 12 hours per day and three 9 hours per day from Dec. 30 to Feb. 2; four towers were operated 8 hours per day from May 24 to 31; and three towers were operated 8 hours per day from June 1 to 30. Quantities shown are bucket measurement.

## EXHIBIT D.—PERFORMANCE OF CRUSHED STONE, SAND, AND CONCRETE PRODUCING AND HANDLING PLANTS, FISCAL YEAR 1913—Continued.

TABLE 3.—Performance of sand-unloading cranes—Balboa, fiscal year ended June 30, 1913.

[Plant consists of three electrically-operated cranes.]

## SIXTH DIVISION.

Month.	Number of cranes operated.	Material handled.	Unloading.	Delays.				Total hours operated per month.	Rate per hour per crane.		Per cent of hours at work to hours operated.
				Repairs.	Waiting for barges.	Waiting for cars.	Other delays.		Working time.	Total time.	
		<i>Cu. yds.</i>	<i>Hours.</i>	<i>Hours.</i>	<i>Hours.</i>	<i>Hours.</i>	<i>Hours.</i>		<i>Cu. yds.</i>	<i>Cu. yds.</i>	
July.....	2	51,470	285.50	.....	.....	130.50	.....	416.00	180.28	123.73	68.63
August.....	2	49,111	299.00	.....	.....	129.00	.....	432.00	164.25	113.68	69.21
September.....	2	39,385	281.00	4.00	.....	87.00	4.00	384.00	140.16	102.57	73.17
October.....	2	41,986	295.00	.....	.....	137.00	.....	432.00	142.33	97.19	68.29
November.....	2	35,821	239.00	5.00	.....	132.00	.....	376.00	149.88	95.27	63.57
December.....	2	38,870	214.50	.....	.....	163.50	6.00	384.00	181.64	101.22	55.86
January.....	1.65	46,318	210.00	.....	.....	97.00	1.00	308.00	220.56	150.38	58.18
February.....	1.96	35,039	207.00	.....	.....	141.00	.....	348.00	169.27	100.60	59.48
March.....	1.96	31,798	226.00	.....	.....	180.00	.....	392.00	140.70	81.12	57.65
April.....	2	24,454	210.00	.....	.....	206.00	.....	416.00	116.43	98.78	50.48
May.....	1.96	21,776	215.00	.....	.....	177.00	.....	392.00	101.28	55.55	54.85
June.....	2	29,630	256.00	2.00	.....	160.00	.....	418.00	115.74	70.89	61.24
Total.....	1.96	445,658	2,938.00	17.00	.....	1,720.00	23.00	4,698.00	151.69	94.86	62.54
Per cent of total.....			62.54	.36	.....	36.61	.49	100.00	.....	.....	.....

Two cranes were operated eight hours per day throughout the year, one being held in reserve.

TABLE 4.—*Performance of Ancon quarry, fiscal year ended June 30, 1913.*

[Plant consists of one No. 12 and four No. 6 crushers.]

## FIFTH DIVISION.

Month.	Crushed rock produced.	Crushing.	Delays.					Total unit hours operated per month.	Average quantity produced per hour.		Per cent of hours at work to hours operated.
			Repairs.	Crusher choked.	Waiting for stone.	Bins full, no cars.	Other delays.		Working time.	Total time.	
	<i>Cu. yds.</i>	<i>Hours.</i>	<i>Hours.</i>	<i>Hours.</i>	<i>Hours.</i>	<i>Hours.</i>	<i>Hours.</i>		<i>Cu. yds.</i>	<i>Cu. yds.</i>	
July.....	61,053	188.51	14.07	1.41	10.66	1.50	17.76	234.00	323.87	260.91	80.56
August.....	70,383	211.33	7.59	2.33	8.24	15.84	31.67	243.00	333.04	289.64	86.97
September.....	41,379	161.09	14.97	1.83	8.00	29.61	54.91	216.00	256.87	191.57	74.58
October.....	61,004	196.42	7.43	2.17	7.77	29.13	46.58	243.00	313.63	253.51	80.84
November.....	54,048	181.00	9.08	2.75	2.66	1.00	35.00	216.00	208.61	250.22	83.80
December.....	56,620	195.26	7.83	7.5	2.49	12.39	27.74	225.00	289.97	251.64	86.78
January.....	70,188	240.69	13.44	8.41	2.99	34.08	71.31	312.00	291.61	224.96	77.14
February.....	61,544	219.91	21.44	3.58	4.23	6.18	56.09	276.00	279.86	222.99	79.68
March.....	65,743	234.99	16.51	12.42	1.82	13.77	65.01	300.00	279.77	219.14	78.33
April.....	50,092	166.08	8.09	3.00	10.17	34.09	67.92	234.00	301.61	214.07	70.97
May.....	29,274	110.00	82.67	6.16	12.60	5.24	124.00	234.00	296.13	125.10	47.01
June.....	54,446	172.83	36.94	16.90	7.23	.58	82.17	255.00	315.03	213.51	67.78
Total.....	676,374	2,278.11	240.06	58.96	78.86	76.10	255.91	2,988.00	296.90	226.36	76.24
Per cent of total.....		76.24	8.04	1.97	2.64	2.55	8.50	100.00			

Plant was operated 12 hours per day from Jan. 2 to Mar. 31 and from June 19 to June 30. The remainder of the year it was operated 9 hours per day.

## EXHIBIT D.—PERFORMANCE OF CRUSHED STONE, SAND, AND CONCRETE PRODUCING AND HANDLING PLANTS, FISCAL YEAR 1913—Continued.

TABLE 5.—Performance of auxiliary mixers (2 yards), *Pedro Miguel*, fiscal year ended June 30, 1913.

[Plant consists of one 2-cubic-yard mixer.]

## FIFTH DIVISION.

Month.	Average number of mixers.	Concrete mixed.	Mixing.	Delays.					Total unit hours per month.	Mixed per hour.		Per cent of hours at work to hours operated.
				Repairs.	Waiting for material.	Waiting for forms.	Waiting for cars.	Other delays.		Working time.	Total time.	
July.....	1	Cu. yds. 4,462	Hours. 114.50	Hours. ....	Hours. 6.25	Hours. 108.00	Hours. ....	Hours. 8.75	237.50	Cu. yds. 38.97	Cu. yds. 18.79	48.21
August.....	1	1,373	63.00	.....	1.50	26.50	2.00	60.00	153.00	21.79	8.97	41.18
Total.....	1	5,835	177.50	.....	7.75	134.50	2.00	68.75	390.50	32.87	14.94	45.45
Per cent of total.....	.....	.....	45.45	.....	1.99	34.44	.51	17.61	100.00	.....	.....	.....

Plant ceased operations on Aug. 17, 1912. Quantities shown are bucket measurements.

TABLE 6.—Performance of auxiliary mixers (2 yards), *Miraflores*, fiscal year ended June 30, 1913.

## FIFTH DIVISION.

Month.	Average number of mixers.	Concrete mixed.	Mixing.	Delays.					Total unit hours per month.	Mixed per hour.		Per cent of hours at work to hours operated.
				Repairs.	Waiting for material.	Waiting for forms.	Waiting for cars.	Other delays.		Working time.	Total time.	
July.....	2.58	Cu. yds. 31,443	Hours. 462.08	Hours. 36.23	Hours. 0.50	Hours. 8.66	Hours. ....	Hours. 260.03	767.50	Cu. yds. 68.05	Cu. yds. 40.97	62.30
August.....	2.00	34,754	480.96	36.18	.....	.....	.....	103.86	621.00	72.32	56.01	77.45
September.....	2.00	19,128	283.08	11.00	.....	.....	.....	137.92	432.00	67.57	44.28	65.53
October.....	1.57	12,248	197.44	11.58	.....	.....	7.20	143.78	360.00	62.03	34.02	51.74
Total.....	2.06	97,603	1,423.56	94.99	.50	8.66	7.20	645.59	2,180.50	68.56	44.76	65.29
Per cent of total.....	.....	.....	65.29	4.36	.02	.40	.33	29.60	100.00	.....	.....	.....

Plant closed on Oct. 26, 1912.

TABLE 7.—Performance of beam cranes, Miraflores, fiscal year ended June 30, 1913.

[Plant consists of four electric cranes situated on berm of locks. Each crane is equipped with a battery of two 2-cubic-yard mixers.]

## FIFTH DIVISION.

Month.	Average number of—		Concrete mixed.	Time working.			Delays.					Total crane, house.	Mixer.		Average per mixer per hour.		Per cent of crane working time to hours operated.	
	Cranes.	Mixers.		Mixing and placing.	Handling forms, steel, and other material.	Total.	Repairs to cranes.	Repairs to mixers.	Waiting for forms.	Bridge-ing.	Other delays.		Total delays.	Work-ing time.	Total time.	Work-ing time.		Total time.
			Cu. yds.	Hours.	Hours.	Hours.	Hours.	Hours.	Hours.	Hours.	Hours.	Hours.	Hours.	Hours.	Cu. yds.	Cu. yds.		
July.....	3.84	6.65	23,518	503.60	56.58	560.18	25.17	0.67	194.50	88.03	65.45	373.82	934.00	858.63	1,592.47	27.39	14.77	59.98
August.....	4.00	6.96	27,734	485.76	34.66	520.42	15.60	2.58	271.34	86.58	152.98	539.08	1,079.50	845.22	1,878.33	32.81	14.77	48.21
September.....	3.71	6.17	16,908	335.16	24.18	359.34	14.16	.38	288.45	26.65	112.02	441.66	801.00	557.37	1,332.06	30.34	12.69	44.86
October.....	3.93	6.67	28,790	384.36	33.84	418.20	4.50	1.84	315.56	60.07	213.83	595.80	1,014.00	652.26	1,720.76	44.05	16.69	41.24
November.....	3.83	7.02	33,556	375.76	26.74	402.50	18.42	3.16	91.84	68.83	399.75	492.00	894.50	688.77	1,639.62	48.72	20.46	45.00
December.....	3.96	7.89	41,262	497.41	8.33	505.74	45.08	6.92	119.83	59.52	213.91	445.26	951.00	990.84	1,894.39	41.64	21.78	53.18
January.....	4.00	8.00	44,048	524.16	12.00	536.16	51.93	10.91	86.41	70.93	179.66	399.84	936.00	948.32	1,872.00	42.02	23.53	57.28
February.....	3.83	7.74	32,072	404.58	14.25	418.83	13.50	4.16	137.35	60.50	157.66	373.17	792.00	817.66	1,603.63	39.22	20.00	52.88
March.....	3.24	6.48	23,878	353.23	5.00	358.23	10.42	4.08	189.83	28.01	167.41	399.75	758.00	706.50	1,516.00	33.50	15.75	47.26
April.....	2.00	4.00	14,306	188.74	30.25	218.99	.42	2.90	127.09	15.78	105.82	252.01	471.00	377.48	942.00	37.60	15.19	46.49
May.....	1.65	3.31	12,623	170.91	1.00	171.91	4.16	1.00	105.42	5.17	108.34	224.09	386.00	341.82	732.00	36.93	15.94	43.41
June.....	1.00	2.00	10,279	139.16	6.00	145.16	2.00	.25	.....	7.69	93.40	103.34	238.50	278.32	497.00	36.93	20.68	38.41
Total.....	3.24	6.07	308,914	4,362.85	252.83	4,615.68	205.36	38.85	1,927.62	577.76	1,910.23	4,659.82	9,275.50	8,163.19	17,280.26	37.84	17.88	49.76
Per cent of total.....	.....	.....	.....	47.04	2.72	49.76	2.21	.42	20.78	6.23	20.60	50.24	100.00	47.24	100.00	.....	.....	.....

Four cranes were operated 9 hours per day from July 1 to 26, 1912; from Aug. 31 to Oct. 15, 1912; and from Dec. 15 to Mar. 25, 1913. Two cranes were operated 12 hours per day and two 9 hours per day from July 27 to Aug. 30 and from Oct. 21 to Dec. 14, 1912. One crane was operated 12 hours per day and three 9 hours per day from Oct. 16 to 21, 1912. Two cranes only were operated 9 hours per day from Mar. 28 to May 14, 1913; and one crane 9 hours per day from May 15 to June 30, 1913. Quantities shown are bucket measurement.

## EXHIBIT D.—PERFORMANCE OF CRUSHED STONE, SAND, AND CONCRETE PRODUCING AND HANDLING PLANTS, FISCAL YEAR 1913—Continued.

TABLE 8.—Performance of chamber cranes, Miraflores, fiscal year ended June 30, 1913.

[Plant consists of four electric cranes operating in lock chambers.]

## FIFTH DIVISION.

Month.	Average number of cranes.	Material handled.			Time working.				Delays.				Total unit hours operated per month.	Material handled per hour.		Per cent of hours at work to hours to hours operated.
		Concrete.	Filling.	Total.	Placing material.	Handling steel forms.	Total.	Repairs to cranes.	Waiting for material.	Waiting for forms.	Bridge-ing.	Other delays.		Work-ing time.	Total time.	
		<i>Cu. yds.</i>	<i>Cu. yds.</i>	<i>Cu. yds.</i>	<i>Hours.</i>	<i>Hours.</i>	<i>Hours.</i>	<i>Hours.</i>	<i>Hours.</i>	<i>Hours.</i>	<i>Hours.</i>	<i>Hours.</i>		<i>Cu. yds.</i>	<i>Cu. yds.</i>	
July.....	3.48	30,705	6,211	36,916	689.46	97.73	787.19	24.11	255.95	43.74	70.99	64.52	1,256.50	53.54	29.38	62.65
August.....	4.00	42,462	.....	42,462	806.77	133.23	940.00	8.13	222.71	39.75	64.80	30.61	1,306.00	52.63	32.51	71.97
September.....	3.79	22,798	720	23,518	500.33	46.00	546.33	10.82	180.75	15.58	41.53	23.99	819.00	47.00	28.72	66.71
October.....	3.96	24,889	.....	24,889	500.91	90.78	591.69	11.23	368.67	45.57	54.19	46.15	1,117.50	49.69	22.27	52.95
November.....	3.91	18,767	889	19,656	429.92	94.17	524.09	29.69	208.32	18.58	45.91	56.91	883.50	46.69	22.25	59.32
December.....	3.96	24,982	312	25,294	515.07	94.23	609.30	12.83	156.68	98.84	58.92	23.43	963.00	49.01	26.27	63.27
January.....	4.00	24,330	.....	24,330	447.09	63.42	510.51	11.00	155.33	176.50	53.07	29.59	936.00	54.42	25.99	62.40
February.....	3.47	16,897	240	17,137	338.08	91.09	429.17	2.03	110.00	168.00	49.88	14.92	774.00	50.69	22.14	55.45
March.....	3.28	9,633	6,929	15,982	355.00	61.58	416.58	1.67	141.18	147.65	37.00	23.92	768.00	45.02	20.81	54.24
April.....	4.00	2,020	24,652	26,672	462.56	96.33	558.89	8.67	390.62	69.92	44.34	19.56	1,092.00	57.66	24.42	51.18
May.....	3.56	436	22,632	23,068	428.67	4.18	432.85	1.33	608.74	1.00	11.33	26.75	1,083.00	53.81	21.30	39.97
June.....	3.84	796	29,774	30,570	551.16	3.50	554.66	3.33	340.17	10.00	4.50	26.34	939.00	55.46	32.59	59.07
Total.....	3.83	218,135	92,359	310,494	6,025.02	875.24	6,901.26	124.84	3,153.12	835.13	536.46	386.69	11,937.50	51.53	26.01	57.81
Per cent of total.....					50.47	7.34	57.81	1.05	26.41	7.00	4.49	3.24	100.00			

From July 1 to Aug. 31 four cranes were operated 12 hours per day; Oct. 2 to Dec. 14, and from Mar. 23 to June 7, two cranes were operated 12 hours per day and two 9 hours per day; Sept. 1 to Oct. 1, and from Dec. 15 to Feb. 28, four cranes were operated 9 hours per day; Mar. 1 to 22 three cranes were operated 9 hours per day; June 8 to 30 one crane was operated 12 hours per day, and three 9 hours per day. Quantities shown are bucket measurements.

## EXHIBIT E.—COMPARATIVE STATEMENT OF ADMINISTRATIVE AND GENERAL EXPENSES FOR FISCAL YEAR 1912-13.

No.	Item.	Fiscal year—		Increase.	Decrease.
		1913	1912		
1	General administrative expenses.....	\$249, 471.68	\$259, 194.95	.....	\$9, 723.27
2	Miscellaneous general expenses:				
3	On Isthmus.....	111, 134.25	91, 851.49	\$19, 282.76	.....
4	Canal Record.....	21, 524.39	18, 270.04	3, 254.35	.....
5	Clubhouses.....	49, 925.96	50, 565.61	.....	639.65
6	Isthmian Canal Commission band.....	8, 765.99	12, 479.14	.....	3, 713.15
7	In the United States.....	90, 826.71	96, 767.10	.....	5, 940.39
8	Disbursing officers:				
9	On Isthmus.....	75, 578.18	72, 908.32	2, 609.86	.....
10	In the United States.....	36, 848.56	34, 048.69	2, 799.87	.....
11	Examiners of accounts:				
12	On Isthmus.....	194, 881.64	159, 470.05	35, 411.59	.....
13	In the United States.....	12, 914.74	12, 021.02	893.72	.....
14	Passenger transportation on Isthmus.....	109, 938.72	109, 287.90	650.82	.....
15	Telegraph and telephones.....	105, 299.12	143, 634.64	.....	38, 335.52
16	Purchasing expenses in the United States.....	167, 405.86	169, 853.60	.....	2, 447.74
17	Operation of stores.....	503, 358.21	462, 031.90	41, 326.31	.....
18	Recruiting and repatriating.....	77, 777.49	65, 915.45	11, 862.04	.....
19	Quarters.....	448, 603.69	415, 636.75	32, 966.94	.....
20	Construction of buildings, Department of Construction and Engineering.....	3, 887.93	1, 775.96	2, 111.97	.....
21	Repairs to buildings, Department of Construction and Engineering.....	11, 086.69	7, 552.41	3, 534.28	.....
22	Operation docks and wharves, Isthmian Canal Commission.....	15, 278.55	19, 862.68	.....	4, 584.13
23	Operation docks and wharves, Panama Railroad Co.....	46, 166.51	23, 969.98	22, 196.53	.....
	Total.....	2, 340, 674.87	2, 227, 157.68	113, 517.19	.....

## EXHIBIT F.—STATEMENT OF SALARY DISBURSEMENTS BY DEPARTMENTS AND DIVISIONS, AND BY APPROPRIATIONS, FISCAL YEAR ENDED JUNE 30, 1913.

	Officers and employees.		Skilled and unskilled labor.		Total pay rolls.
	Amount.	Per cent of total.	Amount.	Per cent of total.	
Chairman and chief engineer.....	\$1, 285, 831.66	19.11	\$5, 443, 390.02	80.89	\$6, 729, 221.68
Atlantic division.....	650, 168.16	20.84	2, 470, 172.15	79.16	3, 120, 340.31
Central division.....	625, 788.14	14.91	3, 572, 824.43	85.09	4, 198, 612.57
Mechanical division.....	288, 724.02	11.76	2, 166, 939.12	88.24	2, 455, 663.14
Quartermaster's department.....	411, 400.53	33.33	822, 754.72	66.67	1, 234, 155.25
Subsistence department.....	83, 740.39	38.13	135, 885.11	61.87	219, 625.50
Examiner of accounts.....	207, 035.51	99.84	341.15	.16	207, 376.66
Disbursing officer.....	62, 850.09	100.00	.....	.....	62, 850.09
Personal injury claims.....	16, 791.31	9.77	148, 363.64	86.34	165, 154.95
Total construction and engineering.....	3, 632, 329.81	19.75	14, 760, 670.34	80.25	18, 393, 000.15
Sanitary department.....	678, 222.30	76.91	203, 629.43	23.09	881, 851.73
Personal injury claims.....	479.50	73.16	175.91	26.84	655.41
Total sanitary department.....	678, 701.80	76.91	203, 805.34	23.09	882, 507.14
Department of civil administration.....	562, 678.24	96.22	22, 127.84	3.78	584, 806.08
Personal injury claims.....	1, 492.25	92.15	127.12	7.85	1, 619.37
Total department of civil administration.....	564, 170.49	96.20	22, 254.96	3.80	586, 425.45
Total all departments.....	4, 875, 202.10	24.55	14, 986, 730.64	75.45	19, 861, 932.74





## APPENDIX J.

### REPORT OF CAPT. R. E. WOOD, UNITED STATES ARMY, CHIEF QUARTERMASTER, IN CHARGE OF QUARTERMASTER'S DE- PARTMENT.

#### ISTHMIAN CANAL COMMISSION, QUARTERMASTER'S DEPARTMENT, *Culebra, Canal Zone, July 1, 1913.*

SIR: I submit the following report of the operations of the quartermaster's department for the fiscal year ending June 30, 1913:

It was anticipated that the work of the department would diminish during the period. The contrary has been the case, particularly in the two main features of the department—supplies and quarters. The value of the material purchased was greater than ever before, the movement of material was heavy, and the number of employees housed was greater than at any other time.

Subsidiary operations have also been on a more extensive scale. The demolition and reerection of the entire settlements of Balboa and Gorgona have increased the work of the building division; the business of the printing plant was heavier than in any previous year, and the work incident to the disposition of retired material and equipment and the disposition and sale of scrap, obsolete material, and equipment has grown to large proportions.

The cost of operations has decreased slightly as compared with the previous fiscal year. Comparative statement for the past four years is as follows:

	1909-10	1910-11	1911-12	1912-13
Work of the quartermaster's department proper.....	\$1,513,210.40	\$1,182,728.01	\$951,934.39	\$975,710.81
Work performed for other departments.....	684,059.45	663,318.18	793,057.91	721,761.85
Total.....	2,197,269.85	1,846,046.19	1,744,992.30	1,697,472.66

The operations of the department are discussed in detail below:

#### ORGANIZATION.

The operation of the Balboa agency of the Panama Railroad Co. was taken over by this department January 1, 1913.

The Gorgona and Empire storehouses were combined and placed in charge of the Gorgona storekeeper April 1, 1913.

The timekeeping work was transferred to the examiner of accounts on January 1, 1913.

## PERSONNEL.

Changes have occurred as follows:

Col. C. A. Devol was appointed brigadier general on March 4, 1913, was relieved from duty with the Isthmian Canal Commission April 17, 1913, and detailed for duty at Washington, D. C., April 26, 1913.

Lieut. Walter B. Smith, constructing quartermaster, was relieved from duty with the Isthmian Canal Commission, July 1, 1913.

Mr. D. H. Beaman, storekeeper at Empire, resigned, effective April 1, 1913.

Capt. R. E. Wood was appointed chief quartermaster May 27, 1913.

Mr. C. B. Cook was placed in charge of building work May 7, 1913.

Mr. C. H. Mann, chief clerk, was appointed receiving and forwarding agent in charge of the Balboa agency March 1, 1913.

Mr. Joseph Birnie was appointed chief clerk March 1, 1913.

## LABOR.

The force employed increased steadily during the first nine months of the fiscal year until, on March 26, 1913, the number of men employed reached the highest point in the history of the canal work. On that date the effective working force was 44,733, of which 39,089 were on the pay roll of the commission and Panama Railroad Co., and 5,644 on the pay rolls of the contractors handling the work on the lock gates, emergency dams, and other contracts in connection with the work. Below is given a comparative statement of the number of men working at the beginning and the end of the fiscal year and on March 26, 1913:

	June 30, 1912.	Mar. 26, 1913.	June 30, 1913.
Gold.....	4,940	5,993	5,671
Silver.....	30,017	38,740	37,679
Total.....	34,957	44,733	43,350

A total of 45,107 laborers have been brought to the Isthmus since the inception of the work. Of these, 11,873 were from Cuba and European countries, and the balance from Colombia and the West Indies. The constant increase of force created a demand for unskilled labor somewhat in excess of the supply, and in December, 1912, it became necessary to recruit laborers from Barbados; 528 were recruited and shipped to the Isthmus during January and February, 1913.

During the fiscal year 1912 there was a decided decrease in immigration to the Isthmus over the number reported for previous years, the excess of arrivals over departures amounting to but 3,510. This immigration continued small during the first few months of the present fiscal year, but the constant demand for labor by the commission, by outside parties, and the recruiting from Barbados, led to a large movement from the West Indian Islands. The excess of arrivals over departures during the present fiscal year was 9,534, or almost three times as much as for the previous year. This immigra-

tion, together with the recruiting mentioned above, supplied all the labor necessary.

It was anticipated that in the fiscal year 1913 it would be necessary to repatriate a considerable number of the laborers brought to the Isthmus under contract. The constant demand for labor has obviated this and the number of repatriations has been relatively small. A total of 552 Americans were given free transportation and returned to the United States on account of completion of two years' satisfactory service, reduction of force, sickness, undesirability, and other causes. A total of 579 were furnished free transportation to the West Indies and South America, and a total of 102 were furnished free transportation to European countries for similar reasons. There were but 369 contract laborers repatriated to the West Indies.

The question of the disposition of force has been merely postponed. Portions of the canal work are rapidly approaching completion, and the force of unskilled labor will be much reduced during the next few months. Preliminary steps to handle this reduction of force have therefore been taken by requesting the heads of departments and divisions to furnish advance notice when reductions of this character are contemplated. An effort will be made to place the labor to the best advantage on work opening up in near-by countries. All contract laborers will be repatriated.

#### QUARTERS.

On June 30, 1913, there was a total of 23,184 men, women, and children occupying commission quarters; practically the same number as reported at the close of the previous fiscal year. This number was divided as follows:

In gold quarters.....	9, 173
In European quarters.....	4, 295
In West Indian quarters.....	9, 716

There was an increase in the gold and West Indian quarters and a decrease in the European quarters. Over 90 per cent of the American and European employees but less than 25 per cent of the West Indians occupy commission quarters.

The problem of housing employees properly has been a difficult one during the past year. In many respects the situation has borne an analogy to the early period of the canal work. With the opening up of the terminal work and the increased activity on the Pacific side, there has been a shift of the employees to the territory, Pedro Miguel to Balboa, inclusive. There has been a congestion, especially in bachelor quarters, in this territory. To meet the condition it was necessary to move and reerect a large number of houses for use as quarters.

A factor which has contributed to the difficulty in quartering employees has been the demolition of two entire settlements—old Balboa and Gorgona.

The demolition of the settlement of old Balboa necessitated the transfer of the employees living at that point to Ancon and Corozal.

The demolition of the settlement of Gorgona necessitated the transfer and distribution of the employees living at that point to other points on the Isthmus. There were approximately 200 American families, 600 American bachelors, and several hundred West

Indians in commission quarters who had to be cared for at other points. This movement began in March and has been almost completed. Since March 1 no assignments to married quarters have been made in the territory between Bas Obispo and Balboa, and all vacancies occurring were given to employees transferred from the Gorgona district.

At the close of the fiscal year the congestion had been relieved at all points except at Balboa and Ancon. It is anticipated that quarters now being erected will care for the force at those points.

#### ZONE SANITATION.

An exact record of the area of grass cut, and of the cost of cutting, was kept during the past fiscal year. All grass cut was on requests from the sanitary department. Total amount cut was 7,356 acres. Of this, 4,822 acres were cut by scythe at an average cost of \$9.05 per acre, and 2,534 acres by horse mowers at an average cost of \$1.77 per acre. These figures do not include brush, all of which was cut by hand.

A reduction of the unit cost has been effected by the increased use of horse mowers. Considerable areas have been cut by machines, which at one time it was not thought possible to cover except by scythemen.

A comparison of the cost of sanitary work performed by this department for the past four years is given below:

	1910	1911	1912	1913
Sanitation proper.....	\$233,093.00	\$210,403.29	\$180,675.67	\$125,983.21
Hospitals, quarantine, etc.....	97,139.81	77,284.48	71,092.40	63,700.96
Total.....	330,832.81	287,687.77	251,768.07	189,684.17

#### CORRALS.

On June 30, 1913, there were 527 public animals stabled in the commission corrals.

Throughout the year the supply of animal transportation has been inadequate to meet the demand. Fifty mules were purchased in the United States at a cost of \$10,562, and were received on the Isthmus May 26. These animals scarcely more than replaced the animals which were condemned or which died during the year. The supply is still inadequate.

Besides the animals purchased in the United States, 12 horses were turned over by the police and fire departments to the quartermaster's department.

Six horses and 20 mules were condemned and destroyed, 5 horses and 4 mules died, a total loss of 35 animals. This loss is less than for many previous years, and is very small considering the age and condition of a large number of the animals.

## BUILDING CONSTRUCTION.

There are 2,618 buildings on the Canal Zone owned by the commission, of which 1,856 are of American construction and 762 of French construction. This represents a decrease of 121 from the total of the preceding year.

The distribution of the buildings has been decidedly altered during the past year on account of the large number of buildings moved from one locality to another.

Twenty-one buildings were sold, 122 demolished, and 4 blown down or destroyed by fire. Most of the buildings sold were located in Nombre de Dios, which has been abandoned. The majority of the buildings demolished were located at Bas Obispo, Culebra, Balboa, and Naos Island. Those at Balboa were torn down on account of the terminal work, those at Culebra on account of slides, and those at Naos Island on account of changes due to the work. The majority of buildings sold and demolished were small and of little value.

The amount of new construction was less than during any previous year of the canal work—20 new buildings were put up and 15 additions. Most of the buildings were small, there being but two that cost over \$2,000. Most of the cost of additions is chargeable to the Tivoli Hotel.

The work of removing and reconstructing buildings was on a very large scale. Buildings at Gatun Spillway, in the old Balboa and Gorgona settlements, and in the slide area at Culebra were moved and reconstructed at other points. In all such cases the buildings moved were of American construction. It has been necessary to replace but little of the material originally put in them.

Twenty buildings were demolished and 19 rebuilt. Sixty-two buildings were taken down in sections and reconstructed in new locations. The cost of the completed work amounted to \$142,000, which does not include buildings in the course of reconstruction on June 30, 1913, on which \$33,000 had already been expended.

Up to April 1 the new construction, moving, and part of the maintenance work was handled by five traveling gangs of carpenters. The decision to move and reconstruct practically all American buildings in the Gorgona settlement necessitated a large increase of force. Nine new gangs were formed in order to complete the work on schedule time, September 1, 1913.

The carpenter gangs of this department are obtaining quick and economical results from this class of work. For the various standard types of quarters the work is almost on a task basis, as it is known exactly how much it should cost and what time it should take to move and reerect the more common types. The table below shows the average cost of construction of three of the most common types of quarters, the cost of moving and reerecting buildings of this class when this class of work was started three years ago, and the average cost of moving and reerecting during the past fiscal year:

	Average cost of construction.	Cost of moving and reerecting, 1911.	Cost of moving and reerecting, 1912-13.
Type V.....	\$7, 756	\$3, 400	\$2, 211
Type XIV.....	6, 808	3, 127	2, 295
Type XVIII.....	9, 973	4, 000	3, 163

The prompt removal and recreation of these quarters has been of great benefit to the commission. It has solved the problem of quartering the force as the work has shifted, at a cost of less than one-third of what it would cost to construct new buildings of similar types. The buildings taken down have proved to be in surprisingly good condition, and when reerected are fully equal in value to the original investment, as all unsound lumber is replaced, new plumbing connections are put in, and the houses entirely repainted.

As time progresses buildings necessarily require more repair work, yet the total cost of maintenance has decreased by approximately 10 per cent as compared with the cost of the previous year. Comparative statement for the past three years is given below:

	1910-11	1911-12	1912-13
Repair work, quartermaster's department.....	\$156,797.48	\$120,912.21	\$131,557.15
Repair work, sanitary department, department civil administration and divisions.....	38,497.58	47,392.31	17,774.94
Total.....	195,295.06	168,304.52	149,332.09

Statement below summarizes amount and cost of work performed by the building division:

21 new buildings.....	\$21,919.31
15 additions to buildings.....	33,643.29
20 buildings demolished and moved, from which 19 other buildings were constructed.....	28,371.84
62 buildings taken down in sections and moved to new locations, from which 60 buildings were constructed.....	113,345.22
Buildings demolished and in course of construction June 30, 1913.....	33,270.28
Repairs and maintenance of buildings.....	149,332.09
	379,882.03
Work pending from fiscal year 1911-12 included in above statement.....	14,170.63
Building construction 1912-13.....	365,711.40

#### MATERIAL AND SUPPLIES.

##### RECEIPTS.

The value of material received from the United States during the last fiscal year was greater than for any preceding year. It amounted to \$13,980,071. This does not include the sum of \$2,535,860 paid to the McClintic-Marshall Construction Co., nor the value of local purchases on the Isthmus, amounting to \$2,733,867. Receipts of material for the first division were especially heavy, totaling as they did, \$5,653,037, without including the McClintic-Marshall payments.

The tonnage consigned to the commission was slightly less than for the previous year; it amounted to 429,342 tons, carried in 440 steamers. This tonnage does not include piling, nor material consigned to the McClintic-Marshall Construction Co. and the United States Steel Products Co. A larger proportion of the material was carried by Panama Railroad ships and by regular line ships than by tramps. The Panama Railroad Co. and the United Fruit Co. brought approximately half of the material.

## ISSUES.

Mount Hope depot invoiced to the various divisions and subdivisions material to the value of \$10,580,623; part of this was cement and structural material, which did not physically pass through the depot. The volume of issues from the line storehouses was practically the same as for the preceding year. There was an increase in issues from the storehouses at Balboa and Miraflores, and a decrease from those at Gatun and Porto Bello.

The consumption of cement decreased from 1,600,000 barrels in 1912 to 1,200,000 barrels in 1913. Total consumption of cement from the inception of the work has amounted to 5,797,910 barrels. All cement covered by the original contract with the Atlas Co., including the allowable 15 per cent increase, has been taken. The contract was renewed until the termination of the work at the same unit price per barrel. There have been received 33,475,408 cement sacks, of which 29,882,968 have been returned to the United States; of these 269,775 sacks have been rejected. The percentage returned has been 89 per cent; those rejected less than 1 per cent.

The consumption of lumber was approximately 27,000,000 feet board measure—about the same as the preceding year. The total receipts of lumber since the inception of the work have been 231,000,000 feet board measure. Of the lumber received during the fiscal year about 55 per cent was from the Pacific coast, and the balance from the Gulf and Atlantic coasts. The Pacific coast furnishes the greater part of the ordinary form and building lumber and can, in most cases, underbid the eastern sections. The Gulf and Atlantic coasts furnish all car lumber, the majority of the piling, and supply most rush orders.

There has been a marked increase in the demand for piling, receipts being heavier than at any previous period. It has been very difficult to supply the work with lumber and piling. This has been due to the sudden opening up of jobs requiring special sizes of lumber and piling, aggravated by the congestion in shipping and difficulty in obtaining satisfactory deliveries.

The consumption of dynamite decreased materially, the reduction amounting to over 30 per cent. During the fiscal year 7,000,000 pounds were used. The total amount used since the inception of the work has been over 56,000,000 pounds.

## STOCKS.

The stocks on hand at all storehouses on June 30, 1913, amounted to \$3,436,995, a decrease of \$284,217 from the stock on hand June 30, 1912. The stocks at Mount Hope depot, Porto Bello, Toro Point, Gatun, Gorgona, Empire, and Miraflores decreased; stocks at the Cristobal shop store, Pedro Miguel, and Balboa increased. The actual reduction in stock was greater than the net decrease shown above, as approximately \$638,000 worth of material was returned to stock from the various divisions. The largest amounts of stock were returned by the mechanical and central divisions. An analysis of the inventories shows that while the decrease has been fairly well distributed among the various classes of general stock and some classes of repair parts, there have been large increases in the stock of car, steam-

shovel, and ladder dredge repair parts. The increase in car and steam-shovel parts is due to the fact that there have been returned to stock large quantities of spares recovered from steam shovels and cars retired from service.

The problem of supply has been especially difficult during the past year. In view of the prospective completion of the work it was considered advisable to keep the stock on hand at as low a figure as possible and operate on a close margin. There has been no decrease in consumption during the year, and because of the relatively small stock carried shortages have frequently occurred. It has been necessary to send a large number of rush and cable orders and this has increased the work of the supply department on the Isthmus and of the purchasing agency in the United States.

While it is anticipated that there will be a decided decrease in the work during the first half of the fiscal year 1914, there is enough work in sight to gradually absorb most of the general stock now carried in the storehouses or on order. It is also believed that stocks of most classes of spare parts can be worked off, but it is inevitable that there will be left a large surplus on hand of certain classes of spare parts, particularly car, steam-shovel, and locomotive repair parts.

#### OPERATION OF DOCKS.

Sixty-four thousand nine hundred and sixty-five tons of material were received and handled over Dock 14, Cristobal. The unit cost of handling was  $23\frac{3}{4}$  cents per ton.

On January 1, 1913, the operation of the Balboa agency was turned over by the Panama Railroad Co. to the quartermaster's department. This agency received and forwarded all commercial freight at the Pacific terminal. A complete change in organization and methods was effected. Some changes in personnel were made; the position of wharf superintendent was abolished; the control of checkers was transferred from the chief clerk to a chief checker. A cost system was inaugurated. The methods of handling labor were changed. Laborers were divided into gangs; regular day and night shifts were formed. The working hours were changed from 10 to 9.

Short-shipped cargo on the dock was cleared away and physical conditions on the dock improved.

A total of 281,366 tons were handled during the six months period January to June, inclusive, as against 336,562 tons for the corresponding period during the previous year. The unit cost was reduced from \$0.3509 to \$0.3012 per ton. Credit for economy and efficiency in operation is due to Mr. C. H. Mann, who was appointed receiving and forwarding agent, March 1, 1913.

#### SCRAP.

Contract for the purchase and removal of French scrap on the Isthmus was entered into with the Chicago House Wrecking Co. in September, 1911. The records of the Panama Railroad Co. show that 21,730 tons have been collected from points along the line and shipped to the storage yards at Cristobal of the Chicago House Wrecking Co. Including the amount already at Cristobal, it is estimated that the Chicago House Wrecking Co. have approximately 25,000 tons of scrap on hand.



The purchase price of this French scrap was \$215,000. The time allotted for the removal of the material was three years. Almost two years have elapsed and the commission has received but \$13,473 on the purchase price. To date the Chicago House Wrecking Co. have shipped but a little over 600 tons of this French scrap from the Isthmus, of which 300 tons have been copper and brass. The commission has repurchased some cast scrap and a few local sales have been made.

A great many claims have been submitted by the Chicago House Wrecking Co., and a number of disputes have arisen as to the proper interpretation of the contract. The claims were of such far-reaching character and involved title to so much valuable material that, at the recommendation of the chief quartermaster, a committee was convened by the chairman to thoroughly investigate all questions at issue. This committee has not yet submitted its final report.

Early in the fiscal year arrangements were made to award all American shop scrap which had already accumulated and which would accumulate during the fiscal year. Differences of opinion arose between the successful bidder and the chief quartermaster relative to the interpretation of the term "shop scrap." The material was readvertised and a contract entered into with the Chicago House Wrecking Co. covering all American iron and steel scrap already accumulated and to be accumulated in the fiscal year. Under this contract approximately 4,662 tons of American scrap had accumulated at Mount Hope prior to the signing of the contract, and 7,447 tons were shipped in from the various departments and divisions during the year and turned over to the Chicago House Wrecking Co. Payment was to be made for this material on ship's bill of lading as shipped from the Isthmus. To date, of the 12,109 tons but 2,466 tons have been shipped from the Isthmus, for which the commission received \$18,571.

Three shipments of scrap screening recovered from buildings were sent to the United States, from which \$6,866 was realized. Scrap rope and hose were sold to the value of \$4,693.

A quantity of copper and brass scrap had accumulated in the operation of the Gorgona brass foundry. After putting aside the pure copper scrap, intended for use in the permanent foundry, the balance of the scrap, consisting of borings and low grade brass scrap, was sold. Approximately \$75,000 was realized from its sale.

A portion of the lock forms used at Gatun was sold to Mr. M. Rovetta. At the close of the fiscal year approximately 300 tons had been delivered, for which \$2,087 was paid.

The quantity and value of scrap recovered from current operations have been underestimated. The commission will ultimately realize much more from the American scrap—iron, steel, and brass—recovered from shop operations and construction work than it realized from all the material and equipment taken over from the French Company.

Storekeepers have been instructed to carefully collect all scrap of whatever character recovered from the work, and it is intended to sort and classify this scrap with a view to obtaining better value from sales.

## SALES.

Besides the regular issues to departments and divisions of the commission and the Panama Railroad Co., there have been a number of outside sales.

These are made up of sales from regular stock to employees, contractors, private individuals, and companies, and of sales from obsolete storehouses and of retired equipment.

A large amount of material from regular stock has been issued by Mount Hope and line storehouses to contractors connected with the canal work and to outside individuals and companies. Employees have been allowed to purchase from the various storehouses material intended for personal use. Firms holding contracts with the commission have been permitted to purchase material intended for use on their work. A certain amount of stock material has been issued to individuals and companies under conditions agreed upon by the commission and the Panaman Government. Some of the principal purchasers are as follows:

McClintic-Marshall Construction Co.....	\$56,069.56
United States Steel Products Co.....	2,849.69
American Cement Tile Co.....	1,059.08
Other contractors.....	16,921.28
Tenth Infantry.....	6,227.73

On June 30, 1913, the value of stock on hand at the obsolete storehouse was \$431,916, an increase of \$70,000 over the total on hand at the close of the previous fiscal year. During the 12-month period material to the amount of \$329,159 was turned in by the departments and divisions and by storekeepers of the quartermaster's department. Of the total nearly one-half was turned in by the Atlantic division. Material and equipment to the value of \$40,000 was reissued direct to departments and divisions or returned for reissue to regular stock in storehouses. Material and equipment to the value of \$48,487 was sold to employees, nonemployees, and contractors; 75 per cent of this amount was sold to purchasers under bids invited by advertisement.

Circular No. 685, covering a large amount of material in the obsolete storehouse, was issued under date of February 23, 1912. Of the 24 classes advertised awards were made on but 6 classes, as either no bids were received on the other classes or the bids were below the upset price of the material. Circular No. 758 was issued under date of February 1, 1913. Satisfactory bids were received on only 4 of the 27 classes advertised.

Results from these sales apparently demonstrate that this method of sale of the retired material and equipment is not satisfactory. Individuals, firms, or contractors that desire material or equipment buy only when they need it, and their necessities may not coincide with the particular time when the commission may advertise, consequently sales made in this manner will result only to the benefit of the scrap dealer or middleman and will not work either to the advantage of the commission or of the ultimate purchaser. In future, it is believed that on much of the material best results will be obtained by placing a fair upset price on such material and equipment and sell it to whoever may first apply. A board of appraisal has been appointed to place values on all articles that may be put up for sale.

Practically all equipment has been continued in service during the past fiscal year and but little retired. What has been retired is limited to some old French locomotives, a few steam shovels, a few shop tools, and the 42-inch rolling stock formerly in use at the Porto Bello quarry. Equipment to the value of \$32,000 has been sold and paid for. Equipment to the value of \$18,670 was sold to the United Fruit Co. in June, 1913, but delivery has not yet been effected. The principal items in these sales include: 8 steam shovels; 10 Porter locomotives, 42-inch gauge; 24 old French locomotives; 77 cars, 42-inch gauge; 2 unloaders; 2 plows. Besides the items included in these sales there have been some miscellaneous equipment, such as boilers, tanks, engines, and a few shop tools, which have been disposed of.

While a portion of the equipment will be continued in use during the coming fiscal year, and a portion continued in use after the canal is completed, a large percentage of it will undoubtedly be retired during the fiscal year 1914. A catalogue has been prepared giving list and description of all American equipment purchased from the inception of the work up to June 1, 1913. It is intended to distribute this catalogue widely. The storage, disposition, or sale of this surplus and obsolete material and retired equipment during the fiscal year 1914 will be a difficult problem.

Respectfully submitted.

R. E. WOOD,  
*Chief Quartermaster.*

Col. GEORGE W. GOETHALS, United States Army,  
*Chairman and Chief Engineer, Culebra, Canal Zone.*

EXHIBIT 1.—Force actually at work on June 30, 1913.

Department or division.	Silver employees.													Total.		Grand total.	
	Monthly.	Artisans.				Laborers.						Silver.	Gold.				
		44 cents.	32 cents.	25 cents.	20 cents.	16 cents.	Europeans.		20 cents.	16 cents.	13 cents.			10 cents.	7 cents.		5 cents.
							20 cents.	16 cents.									
Construction and engineering.....	4,527	9	10	372	1,453	3,892	3,368	799	109	450	5,773	3,595	237	3	24,597	3,239	27,836
Civil administration.....	138			2	4	25						18			187	297	27,884
Department of sanitation.....	656			3	3	5					8	384	1	1	1,061	356	1,417
Quartermaster's department.....	917			185	231	439	28	4	4	4	279	1,051	21		3,163	198	3,361
Subsistence department.....	712			2	1	1							14		730	48	778
Disbursing office.....	7														7	18	25
Examiner of accounts.....	5														5	76	81
Total.....	6,962	9	10	564	1,692	4,362	3,396	803	113	454	6,060	5,048	273	4	29,750	4,232	33,982
Commissary department, Panama R. R.....	704			4	11	47					15	189	114		1,084	257	1,341
Panama Railroad Co.....	490														3,539	555	4,094
Contractors.....															3,306	627	3,933
Total.....	1,194			4	11	47					15	189	114		7,929	1,439	9,368
Grand total.....	8,156	9	10	568	1,703	4,409	3,396	803	113	454	6,075	5,237	387	4	37,679	5,671	43,350

EXHIBIT 2.—*Force report, by months, fiscal year 1912-13 (including contractors' forces).*

Year and month.	Isthmian Canal Commission.		Panama Railroad Co.		Contractors' forces.		Grand total.
	Gold.	Silver.	Gold.	Silver.	Gold.	Silver.	
1912.							
July.....	4,196	24,186	824	5,963	.....	.....	35,169
August.....	4,122	24,860	817	5,038	24	29	34,890
September.....	4,166	25,405	830	5,460	39	44	35,944
October.....	4,350	25,750	889	5,542	399	2,452	39,382
November.....	4,475	26,119	887	5,179	454	3,045	40,159
December.....	4,323	24,375	939	5,022	588	4,089	39,336
1913.							
January.....	4,501	26,514	931	5,503	596	4,296	42,341
February.....	4,484	27,540	889	5,386	645	4,467	43,411
March.....	4,487	28,080	839	5,683	667	4,977	44,733
April.....	4,358	28,467	944	5,375	655	4,393	44,192
May.....	4,337	27,918	845	5,368	584	3,981	43,033
June.....	4,282	28,931	805	4,283	570	3,391	42,262

EXHIBIT 3.—*High and low force records, December, 1906, to June 30, 1913.*

Year and month.	Isthmian Canal Commission.			Panama Railroad.	Total.
	Gold.	Silver.	Total.	Gold and silver.	
1906.					
December.....	3, 881	15, 604	19, 485	4, 416	23, 901
1907.					
October.....	4, 992	20, 836	25, 828	6, 139	31, 967
January.....	4, 033	16, 987	21, 020	4, 796	25, 816
1908.					
April.....	4, 950	21, 168	26, 118	7, 052	33, 170
November.....	4, 161	19, 803	23, 964	5, 863	29, 827
1909.					
October.....	4, 376	23, 411	27, 787	7, 618	35, 495
January.....	4, 295	20, 583	24, 878	6, 393	31, 271
1910.					
March.....	4, 553	26, 284	30, 837	7, 839	38, 676
December.....	4, 705	24, 383	29, 098	6, 044	35, 142
1911.					
December.....	4, 420	25, 439	29, 859	7, 967	37, 826
June.....	4, 292	21, 795	26, 087	6, 603	32, 690
1912.					
January.....	4, 332	25, 818	30, 150	8, 024	38, 174
August.....	4, 122	24, 860	28, 982	5, 855	34, 837
1913.					
April.....	4, 358	28, 467	32, 825	6, 319	39, 144
January.....	4, 501	26, 514	31, 015	6, 434	37, 449

NOTE.—Figures do not include contractors' forces. If taken into consideration, the greatest working force ever reported was 44,733, on Mar. 26, 1913.

EXHIBIT 4.—*Contract laborers brought to the Isthmus by the Isthmian Canal Commission.*

Country.	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	Total.
Spain.....			1,174	5,293	1,831						8,298
Cuba.....			500								500
Italy.....			909	1,032							1,941
Greece.....				1,101							1,101
France.....			19								19
Armenia.....			14								14
Total Europeans.....			2,616	7,426	1,831						11,873
Fortune Island.....			361								361
Barbados.....	404	3,019	6,510	3,242	2,592	3,605				528	19,900
Guadeloupe.....				2,039					14		2,053
Martinique.....		2,733	585	2,224							5,542
Jamaica.....		47									47
Trinidad.....			1,079				205		143		1,427
Curacao.....			23								23
St. Kitts.....			933						9		942
St. Lucia.....									55		55
St. Vincent.....									296		296
Grenada.....									93		93
British Guiana.....									332		332
Total West Indies.....	404	5,799	9,491	7,505	2,592	3,605	205		942	528	31,071
Costa Rica.....		244									244
Colombia.....		1,077	416								1,493
Panama.....		334	10	13							357
Not classified.....			69								69
Grand total.....	404	7,454	12,602	14,944	4,423	3,605	205		942	528	45,107

EXHIBIT 5.—*Analysis of transportation from the Isthmus, fiscal year 1912-13.*

Months.	To United States of America.									
	Free transportation.						Deportations.			
	Two years' service.		Reduction of force.		144th meeting.		Sickness.		Undesirables.	
	Num-ber.	Amount.	Num-ber.	Amount.	Num-ber.	Amount.	Num-ber.	Amount.	Num-ber.	Amount.
1912.										
July.....	5	\$200.00			12	\$388.00			1	\$15.00
August.....	5	200.00			9	295.00	4	\$160.00		
September.....	1	40.00	1	\$40.00	6	190.00	1	15.00	1	15.00
October.....	12	480.00	1	40.00	4	150.87				
November.....	50	1,992.00	4	160.00	15	478.75	3	95.00	1	15.00
December.....	46	1,840.00	4	160.00			2	21.00	2	30.00
1913.										
January.....	38	1,520.00	1	40.00	5	196.25			3	45.00
February.....	30	1,200.00	1	40.00	1	15.00	3	120.00	1	15.00
March.....	15	576.00			1	21.54	1	40.00		
April.....	96	3,820.00	7	280.00	14	540.00	3	120.00	2	30.00
May.....	52	2,072.00	7	280.00	11	292.50	1	40.00	1	15.00
June.....	61	2,440.00	4	160.00	5	175.00	3	95.00	2	55.00
Total.....	411	16,380.00	30	1,200.00	83	2,742.91	21	706.00	14	235.00

EXHIBIT 5.—Analysis of transportation from the Isthmus, fiscal year 1912-13—Contd.

Months.	To South America and West Indies.							
	Free transportation.				Deportations.			
	Repatriation.		144th meeting.		Sickness.		Undesirables.	
	Num- ber.	Amount.	Num- ber.	Amount.	Num- ber.	Amount.	Num- ber.	Amount.
1912.								
July .....	36	\$380.16	17	\$243.00	18	\$166.00	16	\$185.00
August .....	28	295.68	8	105.00	9	106.50	7	107.00
September .....	3	31.68	1	14.00	5	37.00	9	77.00
October .....	10	105.60	9	148.50	3	54.00	10	99.15
November .....	50	528.00	24	344.00	15	269.00	6	73.00
December .....	23	242.88	8	122.00	9	96.00	11	100.50
1913.								
January .....	4	42.24	1	11.00	2	12.00	6	64.00
February .....	14	148.28	7	118.00	13	237.50	5	73.50
March .....	14	155.78	9	132.56	9	109.50	8	69.50
April .....	23	247.82	12	192.00	15	230.75	8	89.00
May .....	53	576.44	8	160.50	15	252.00	8	80.50
June .....	15	158.40	7	134.00	8	117.50	3	39.00
Total .....	273	2,912.96	109	1,724.56	121	1,687.75	97	1,057.15

Months.	To Europe.						Total.	
	Free transpor- tation.		Deportations.					
	144th meeting.		Sickness.		Undesirables.			
	Num- ber.	Amount.	Num- ber.	Amount.	Num- ber.	Amount.	Num- ber.	Amount.
1912.								
July .....	14	\$442.60	7	\$232.00	.....	.....	126	\$2,251.76
August .....	7	448.96	5	310.00	1	\$36.20	83	2,064.34
September .....	5	181.00	11	371.80	1	11.00	45	1,023.48
October .....	1	36.20	2	72.40	1	36.20	53	1,222.92
November .....	1	36.20	2	72.40	1	8.75	172	4,072.10
December .....			3	108.60	.....	.....	108	2,720.98
1913.								
January .....			2	72.40	1	36.20	63	2,039.09
February .....			4	157.40	2	39.95	81	2,164.63
March .....			4	82.40	2	71.20	63	1,258.48
April .....	2	186.00	7	249.80	1	36.20	190	6,021.57
May .....	2	72.40	3	108.60	2	72.40	163	4,022.34
June .....			7	251.00	1	36.20	116	3,661.10
Total .....	32	1,403.36	57	2,088.80	13	384.30	1,263	32,522.79

EXHIBIT 6.—*Occupants of commission quarters, June 30, 1913.*

Place.	Gold.			Europeans.			West Indians.		
	Men.	Women.	Children.	Men.	Women.	Children.	Men.	Women.	Children.
Balboa.....	289	36	44	325	.....	.....	894	.....	.....
Ancon.....	528	309	240	6	.....	.....	740	5	.....
Corozal.....	769	144	142	382	.....	.....	509	8	5
Miraflores.....	17	2	4	399	4	11	351	7	6
Pedro Miguel.....	329	72	87	293	3	2	238	36	50
Paraiso.....	263	89	93	152	3	11	238	106	159
Culebra.....	363	153	151	478	48	93	414	111	176
Empire.....	700	295	287	417	52	73	488	143	222
Las Cascadas.....	192	105	145	20	12	33	231	148	171
Bas Obispo.....	78	46	38	132	10	23	146	41	53
Gorgona.....	373	72	65	29	.....	.....	365	69	132
Gatun.....	674	206	211	916	20	23	708	29	12
Cristobal.....	760	294	327	127	.....	.....	1,559	224	365
Toro Point.....	46	14	18	82	.....	.....	253	.....	.....
Porto Bello.....	60	22	21	116	.....	.....	301	1	2
Total.....	5,441	1,859	1,873	3,874	152	269	7,435	928	1,353

Gold force of contractors in quarters (included above): Families, 33; bachelors, 542.

EXHIBIT 7.—*Applications for married quarters on file June 30, 1913.*

Stations.	List No. 1.	List No. 2.	Stations.	List No. 1.	List No. 2.
Balboa.....	.....	56 (1)	Bas Obispo.....	.....	15 (1)
Ancon.....	11 (4)	106 (24)	Gatun.....	.....	75
Ancon Hospital.....	1 (1)	5	Cristobal.....	.....	142 (1)
Corozal.....	.....	130 (15)	Toro Point.....	.....	6
Pedro Miguel.....	.....	52	Porto Bello.....	.....	14 (9)
Culebra.....	2	31 (6)	Total.....	21 (11)	751 (91)
Empire.....	7 (6)	90 (28)			
Las Cascadas.....	.....	29 (6)			

NOTE.—The figures in parentheses show the number of applicants already occupying regular or non-housekeeping family quarters at stations other than those at which applications are filed.

EXHIBIT 8.—*Animals in corrals, June 30, 1913.*

Stations.	American horses.	Native ponies.	Mules.	Police animals.	Private animals.	Total.
Ancon.....	32	6	112	11	30	191
Corozal.....	1	.....	28	1	.....	30
Pedro Miguel.....	.....	2	25	4	7	38
Culebra.....	6	2	23	.....	12	43
Empire.....	7	5	34	6	26	78
Las Cascadas.....	1	1	29	3	1	34
Gorgona.....	.....	1	15	1	8	25
Gatun.....	2	1	51	4	1	59
Cristobal.....	17	1	95	1	10	116
Total.....	65	19	412	31	95	614

<sup>1</sup> Includes 8 Panama Railroad (commissary) mules.



EXHIBIT 9.—Number of buildings on the Canal Zone, June 30, 1913.

Stations.	Isthmian Canal Commission.	French.	Total.	Stations.	Isthmian Canal Commission.	French.	Total.
Alhajuela.....	2	2	4	Las Sabanas.....	2		2
Ancon.....	211	39	250	Margarita Island.....	7		7
Balboa.....	90	4	94	Miraflores.....	31	26	57
Bas Obispo.....	65	119	184	Naos Island.....	16		16
Camp "E. S. Otis".....	21	34	55	New Frijoles.....	1		1
Colon Hospital.....	37	10	47	Palo Seco.....	16		16
Corozal.....	116	27	143	Panama.....	1	2	3
Cristobal.....	153	103	256	Paraiso.....	99	60	159
Crucis.....	1		1	Pedro Miguel.....	100	19	119
Culebra.....	174	51	225	Porto Bello.....	53		53
Culebra Island.....	9		9	Taboga Island.....	9		9
Empire.....	194	106	300	Toro Point.....	33	1	34
Flamenco Island.....	3		3	Vigia.....	1		1
Gatun.....	238		238	Total.....	1,856	762	2,618
Gorgona.....	87	102	189				
Las Cascadas.....	86	57	143				

EXHIBIT 10.—New construction, fiscal year 1912-13.

Department or division.	New structures.		Additions.		Total.	
	Num- ber.	Cost.	Num- ber.	Cost.	Num- ber.	Cost.
Quartermaster's department and general use....	4	\$2,981.21	1	\$120.67	5	\$3,101.88
Chief engineer:						
First division.....	7	5,503.49			7	5,503.49
Second division.....	1	990.63			1	990.63
Fortification division.....	2	1,768.99			2	1,768.99
Central division.....	1	2,977.23			1	2,977.23
Mechanical division.....			1	342.42	1	342.42
Atlantic division.....	1	367.77			1	367.77
Subsistence department.....			8	29,600.16	8	29,600.16
Sanitary department.....			1	126.53	1	126.53
Canal Zone government.....			1	400.33	1	400.33
Commissary department.....	1	456.07	3	3,053.18	4	3,509.25
Tenth Infantry, United States Army.....	2	870.76			2	870.76
Melendez House, account 401.....	1	4,463.68			1	4,463.68
United States Marine Corps.....	1	1,539.48			1	1,539.48
Total.....	21	21,919.31	15	33,643.29	36	55,562.60

## SUMMARY.

21 new buildings.....	\$21,919.31
15 additions to buildings.....	33,643.29
20 buildings demolished and moved, from which 19 other buildings were constructed.....	28,371.84
62 buildings taken down in sections and moved to new locations, from which 60 buildings were constructed.....	113,345.22
Buildings demolished and in course of construction June 30, 1913.....	33,270.28
Repairs and maintenance of buildings.....	149,332.09
Work pending from fiscal year 1911-12 included in above statement.....	379,882.03
Buildings construction, 1912-13.....	14,170.63
	365,711.40

EXHIBIT 11.—*Buildings sold and demolished, fiscal year 1912-13.*

Stations.	Buildings sold.		Buildings demolished.	Total sold and demolished.
	Number.	Amount received.		
Naos Island.....			8	8
Balboa.....			36	36
Ancon.....			3	3
Miraflores.....			3	3
Pedro Miguel.....			4	4
Paraiso.....	4	\$200.00		4
Culebra.....			29	29
Empire.....	1	80.00	3	4
Las Cascadas.....			8	8
Bas Obispo.....	5	260.00	14	19
Gorgona.....			4	4
Gatun.....			7	7
Cristobal.....	1	100.00	3	4
Toro Point.....			2	2
Porto Bello.....			2	2
Nombre de Dios.....	10	355.00		10
Total.....	21	995.00	126	147

EXHIBIT 12.—Value of material received during the fiscal year 1912-13 on requisitions of the various departments.

Departments.	1912						1913						Total.
	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	
Construction and engineering:													
Atlantic division.....	\$23,440.81	\$42,741.72	\$18,345.84	\$14,237.69	\$44,634.92	\$35,037.76	\$55,801.61	\$94,735.10	\$72,805.32	\$161,569.25	\$109,713.02	\$13,285.20	\$686,148.27
Central division.....	2.25			28.60			1,388.40	900.00			7.00		2,326.25
Pacific division.....	187,627.79	142,511.74	62,423.99	62,716.19	163,191.91	159,780.36	153,502.37	128,851.35	101,792.90	137,577.62	98,419.50	11,733.59	778,251.93
Fifth division.....							4,854.38	6,333.46	7,647.84	22,762.78	9,443.40	18,192.27	69,209.13
Sixth division.....	278,325.92	432,838.65	375,197.54	529,171.68	324,475.80	403,684.63	1,134,660.28	475,804.03	377,764.80	407,887.50	541,089.40	378,137.23	5,653,037.46
First division.....							26,352.53	5,868.60	1,951.22	22,276.63	156,476.63	188,672.39	401,598.02
Second division.....							1,062.95	1,498.59		602.52	935.15	818.64	12,828.65
Fourth division.....	498.80	636.87	1,335.88	35,953.01	49,354.58	27,672.86	1,009.67	1,100.27	743.67	92,113.18	123,956.21	74,057.21	771,782.05
Mechanical division.....	55,018.57	68,725.91	54,775.74				40,351.88	60,305.14	87,407.70				
Fortifications.....	17,452.93	12,174.69	13,479.71	21,116.24	25,915.21	8,921.43	8,960.54	1,494.18	1,754.06	1,855.93	9,197.00	23,443.08	145,765.60
Total.....	562,367.10	699,629.58	525,558.70	664,286.36	609,071.01	635,699.56	1,426,941.66	775,572.23	645,668.26	846,978.04	1,052,712.72	708,339.61	9,152,824.83
Quartermaster's department.....	355,918.34	318,786.69	364,794.47	341,617.73	314,868.35	214,294.14	360,653.54	316,251.73	279,298.08	429,631.45	275,896.64	382,891.54	3,045,903.30
Sanitary department.....	8,943.66	7,290.18	7,124.95	2,364.62	5,487.51	5,141.38	2,937.65	4,743.88	6,157.00	3,414.02	8,213.51	5,670.44	67,489.40
Examiner of accounts.....		252.65		42.00	300.00	224.48		745.00	20.67		450.00	627.75	2,662.55
Disbursing officer.....							232.16						464.33
Department of civil administration.....	380.57	4,772.14	667.15	3,957.30	1,037.22	558.26	378.39	631.35	678.15	201.08	524.17	226.98	14,102.76
Department of law.....	5.50	13.50	4.00	15.50	3.50	8.00	8.10	7.50	7.50		290.50	231.60	595.20
Panama Railroad Co.....	62,807.38	94,169.86	114,348.74	116,055.80	45,688.60	34,363.80	75,667.90	66,800.00	21,752.25	47,292.53	34,451.32	79,631.06	796,029.44
Grand total.....	990,422.55	1,124,914.60	1,012,498.01	1,128,339.31	979,456.19	890,289.62	1,866,819.10	1,164,751.69	944,583.61	1,327,607.12	1,379,771.03	1,177,618.98	13,980,071.81
Local purchases on the Isthmus:													
Coal purchased from Panama Railroad Co.....	132,222.18	124,146.91	116,100.85	123,767.04	122,144.16	127,013.27	122,326.43	115,984.58	130,307.86	128,335.65	132,708.10	117,265.49	1,492,322.52
Miscellaneous purchases from Panama Railroad.....	2,293.12	31,258.66	13,000.68	37,666.65	7,032.12	8,105.74	2,018.35	12,865.45	35,457.67	9,974.20	22,427.17	15,503.88	197,603.69
Miscellaneous purchases from Panama Railroad commissary.....		1,903.90	6,961.54	1,615.95	8.75	5,070.59	1,017.27	3,685.72	1,491.82	1,689.84	1,513.45	645.74	25,604.57
Crude oil from Union Oil Co.....	90,717.77	82,316.20	82,365.18	83,789.67	76,476.24	87,253.15	86,390.88	72,653.14	87,332.62	78,353.35	79,014.83	86,745.89	995,408.92

EXHIBIT 12.—Value of material received during the fiscal year 1912-13 on requisitions of the various departments—Continued.

Departments.	1912						1913						Total.
	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	
Local purchases on the Isthmus—Contd.													
Miscellaneous purchases from local merchants.....	\$1,002.08	\$1,519.61	\$358.06	\$4,060.76	\$4,594.45	\$3,388.20	\$1,177.37	\$408.63	\$1,694.31	\$733.84	\$642.06	\$2,593.44	\$22,672.81
Postage stamps.....	95.00	60.00						45.00				55.00	255.00
Total (local purchases on Isthmus) .....	226,330.15	243,205.28	219,286.31	250,900.07	210,255.72	230,830.95	212,930.30	205,642.52	256,284.28	219,086.88	236,305.61	222,809.44	2,733,867.51

NOTE.—In addition, there was paid to the McClintic-Marshall Construction Co., on Washington order No. 23444, for lock-gate leaf material inspected and accepted, the sum of \$2,535,860.09.

Pacific division shows values from July 1, 1912, to Dec. 31, 1912; second division shows values from Jan. 1, 1913, to June 30, 1913; fifth division shows values from Jan. 1, 1913, to June 30, 1913; sixth division shows values from Jan. 1, 1913, to June 30, 1913.

EXHIBIT 13.—*Freight statement, fiscal year 1912-13.*

Steamship lines.	Number of steamers.	General cargo.	Lumber.	Ties.		Piling.	Total weight.	
		<i>Pounds.</i>	<i>Feet b. m.</i>	<i>Pieces.</i>	<i>Feet b. m.</i>	<i>Pieces.</i>	<i>Pounds.</i>	<i>Tons.</i>
Panama Railroad Co..	80	<sup>1</sup> 350,057,018	97,889				350,448,574	175,224
Royal Mail Steam Packet Co.....	10	758,834					758,834	379
California Atlantic.....	6	900,226	1,648,790				7,495,386	3,748
Leyland Line.....	19	1,243,521					1,243,521	622
United Fruit Co.(New York).....	103	34,670,184	25,604				34,772,600	17,386
United Fruit Co.(New Orleans).....	74	24,058,992	11,709,446	55,471	2,482,326	8,705	80,826,080	40,413
Hamburg American.....	59	5,541,587					5,541,587	2,771
Tramps, Atlantic.....	59	<sup>2</sup> 287,281,768	1,311,816	188,364	8,532,273	11,260	326,658,124	163,329
Tramps, Pacific.....	12	1,144,328	11,773,198	6,161	379,338	1,200	49,754,472	24,877
Pacific Mail.....	15	402,662	181,357				1,128,090	564
Harrison Line.....	3	57,217					57,217	29
Total.....	440	<sup>3</sup> 706,116,337	26,748,100	249,996	11,393,937	21,165	858,684,485	429,342

<sup>1</sup> Includes 291,291,200 pounds of cement equal to 728,228 barrels.<sup>2</sup> Includes 190,215,600 pounds of cement equal to 475,539 barrels.<sup>3</sup> Includes 481,506,800 pounds of cement equal to 1,203,767 barrels.

NOTE.—The total weights given above do not include the weights of piling.

EXHIBIT 14.—*Important items due on United States requisitions, June 30, 1913.*

Articles.	Quantity.	Value.
Barges, steel, 1,000-yard.....	6	\$366,000.00
Bridge, bascule, over French canal.....	1	50,000.00
Caissons, lock entrance, floating.....	2	<sup>1</sup> 480,000.00
Cranes, floating.....	2	837,500.00
Dredges, dipper, 15-yard.....	2	517,000.00
Dynamite.....pounds..	2,185,250	248,146.03
Equipment for Balboa permanent shops:		
Electric traveling cranes.....		61,715.00
Reversing motor planer equipments.....		5,620.00
Sand-blast equipment.....		6,754.00
Motors and control apparatus.....		60,075.10
Oil-burning furnaces.....		13,740.00
Extension planer.....		22,000.00
Double engine lathe, motor driven.....		22,000.00
Forging press.....		12,000.00
Leaves, gate, for Balboa dry dock.....	2	203,904.10
Lumber.....feet b. m..	11,614,162	110,123.06
Material for locks:		
Lock gate leaves (amount not paid).....		1,191,020.66
Material for chain fenders.....		307,970.40
Electric towing locomotives.....		502,591.00
General control apparatus for lock machinery.....		109,638.00
Cable.....		137,705.31
Transformer equipment.....		15,521.69
Auxiliary electric equipment for hydroelectric station, Gatun.....		34,364.33
Lighting material for all locks.....		11,344.50
Frames and covers for decking lock walls.....		16,070.92
Machinery for upper guard valves.....		17,934.34
Railings for spillways and doors for operating tunnels.....		7,710.00
Material for Cristobal-Balboa transmission line.....		2,351,871.15
Piling.....pieces..	4,111	995,934.07
Plants, coal-handling.....	2	76,287.68
Steel, structural:		
Balboa shops buildings.....		246,360.00
Cristobal terminal locks.....		112,739.53
Balboa terminals.....		50,561.00
Ties, cross....	50,000	409,660.53
		51,000.00

<sup>1</sup> Estimated value.

EXHIBIT 15.—*Important items of material purchased from inception of canal work, 1904 to June 30, 1913.*

Articles.	Quantity.	Value.
Barges (includes six not yet received).....	50	\$1,458,830.00
Boats, tug.....	9	566,734.00
Brick, building, fire and paving.....		281,013.26
Cableways.....	7	365,050.90
Cars.....	4,181	4,655,355.79
Cement.....barrels..	5,797,910	5,880,050.58
Compressors, air.....	28	125,504.77
Cranes.....	87	666,228.81
Dredges (includes two not yet received).....	16	2,809,128.00
Drills, rock.....	725	288,376.59
Drivers, pile.....	4	28,305.00
Explosives:		
Dynamite.....pounds..	56,220,989	6,740,233.46
Other blasting supplies.....		660,541.08
Forage and corral supplies.....		783,442.05
Furniture:		
Married quarters.....		271,025.74
Bachelor quarters.....		147,143.50
Hospital quarters.....		76,666.65
Laborers' quarters.....		208,809.00
		703,644.89
Live stock:		
Horses.....		39,212.50
Mules.....		110,135.00
Cows.....		10,650.00
		159,997.50
Locomotives.....	189	1,942,502.00
Lumber.....feet b. m..	231,422,554	5,651,029.98
Material for locks.....		12,782,395.43
Piling.....pieces..	153,113	1,863,278.82
Plants:		
Power.....	3	366,523.97
Material handling.....	3	689,358.60
Rock crusher.....	4	200,164.68
Filtration.....	4	101,162.14
Pumping.....	2	14,950.00
Boiler.....	2	114,961.00
Hydraulic dredging.....	1	192,868.00
Steel foundry.....	1	11,742.39
		1,691,730.78
Rails, steel.....	62,537	1,970,419.75
Roofing, corrugated iron.....		503,162.45
Screening, wire.....		413,921.47
Shovels, steam.....	102	1,094,879.96
Spreaders, earth.....	26	139,687.00
Ties, cross and switch.....	2,240,871	1,898,258.98
Unloaders.....	29	158,839.00

EXHIBIT 16.—*Important items of material received, July 1, 1912, to June 30, 1913.*

Articles.	Quantity.	Value.
Bridge, bascule.....	1	\$24,390.00
Cement.....barrels	1,203,767	1,107,455.64
Dynamite.....pounds	6,410,600	759,417.50
Other blasting supplies.....		73,737.35
Forage and corral supplies.....		76,329.55
Lumber.....feet b. m.	26,418,200	828,847.86
<b>Material for locks and lock work:</b>		
Lock gate leaves (amount paid).....		2,535,860.09
Spare parts for same.....		109,641.64
Emergency dams (value of material received).....		2,045,996.23
Machinery to operate Stoney Gate valves.....		732,797.15
Locomotive track material.....		125,828.01
Lock gate recess covers.....		1,544.61
Miter gate moving and forcing machinery.....		760,397.61
Gates, caissons, fixed irons, etc., for spillways.....		172,076.36
Plant and materials for hydroelectric station.....		138,341.58
Material for chain fenders for all locks.....		60,498.60
Electric towing locomotives.....		24,951.00
Snubbing posts and springs, etc.....		7,804.92
Spillway gate machines and spares.....		71,363.29
Miscellaneous material for rack railways and miter gates.....		8,636.87
Crank gear recess cover seats.....		18,848.10
General control apparatus for lock machinery.....		108,062.46
Motors, centrifugal pumps, etc.....		135,934.11
Crossovers for electric towing locomotives.....		44,142.00
Cable.....		419,680.17
Transformer equipment.....		267,901.56
Auxiliary electrical equipment for hydroelectric station.....		5,810.67
Lighting material for all locks.....		6,775.50
Frames and covers for decking of lock walls.....		1,776.33
Miscellaneous material for power and control wiring.....		10,889.60
Machinery for upper guard valves.....		8,966.66
Conduit and miscellaneous material for power and control wiring.....		2,954.85
		7,827,479.88
<b>Material for lighting and buoying the canal.....</b>		164,970.00
Oils and greases.....		106,098.12
Piling.....pieces..	21,035	314,904.82
Steel, flat, round, square, tool, etc.....		208,100.48
Steel, reinforcing.....		104,188.31
<b>Steel, structural:</b>		
Hotel Washington.....		9,917.47
Balboa shops buildings (includes erection).....		184,726.43
Administration building (includes erection).....		103,360.81
Gatun hydroelectric station.....		28,080.24
Cristobal terminal docks.....		258,262.16
Main part of control houses.....		7,607.62
Balboa terminals.....		44,567.34
		636,562.07
<b>Tanks, oil storage.....</b>	4	62,800.00

EXHIBIT 17.—*Classification of material in stock at storehouses.*

Class No.		June 30, 1911.	June 30, 1912.	June 30, 1913.
1	New York air-brake material.....	\$27,369.05	\$21,258.94	\$8,884.82
2	Westinghouse air-brake material.....	56,583.60	46,140.87	32,140.79
3	Lubricators, oil cups, and parts.....	20,295.53	18,358.98	17,763.88
4	Injectors, inspirators, ejectors, and parts.....	39,405.12	35,731.59	35,479.55
5	Pop valves and repair parts.....	15,224.38	13,836.86	14,041.38
6	Steam, air, and vacuum gauges, and parts.....	2,121.25	1,415.11	1,447.87
7	Water gauges and fittings.....	5,156.04	2,971.49	3,604.51
8	Miscellaneous boiler and engines fittings.....	9,093.64	10,392.04	17,373.34
9	Twist drills, reamers, cutters, tools, etc.....	24,194.30	21,363.60	21,645.86
10	Pneumatic and electric hand tools and parts.....	19,469.18	14,523.56	10,621.93
11	General stock of electrical material.....	180,327.44	134,498.56	134,889.69
12	Special stock of electrical material.....	49,970.14	46,571.16	44,347.36
13	Car repair parts.....	188,805.45	143,463.30	239,962.78
14	Crane repair parts.....	62,509.28	52,812.69	49,699.74
15	Locomotive repair parts.....	87,030.35	76,311.04	70,805.29
16	Lidgerwood unloader repair parts.....	13,553.31	14,004.93	13,598.41
17	Spreader repair parts.....	11,202.34	10,596.55	4,133.41
18	Pile driver repair parts.....	1,314.68	957.99	744.75
19	Track shifter repair parts.....	34.72	69.66	162.86
20	Motor car repair parts.....	1,867.06	3,389.92	4,337.91

EXHIBIT 17.—*Classification of material in stock at storehouses—Continued.*

Class No.		June 30, 1911.	June 30, 1912.	June 30, 1913.
21	Steam shovel repair parts.....	\$396,675.98	\$319,550.60	\$347,393.85
22	Rock channeler repair parts.....	1,090.50	543.85	1,995.40
23	Well drill repair parts.....	23,619.00	12,787.21	12,743.35
24	Rock drill repair parts.....	68,628.64	48,566.52	41,602.81
25	Drill sharpener repair parts.....	964.23	887.13	970.62
26	Tugboat repair parts.....	16,406.83	5,102.91	6,384.76
27	Suction dredge repair parts.....	108,754.36	91,209.26	74,334.46
28	Ladder dredge repair parts.....	53,756.33	28,842.54	54,419.14
29	Dipper dredge repair parts.....	39,787.84	25,300.36	26,668.14
30	Clapet repair parts.....	4,286.75	3,805.69	3,803.96
31	Towing machine repair parts.....	3,896.74	3,001.32	3,796.08
32	Barge repair parts.....	3,216.62	4,560.80	6,065.30
33	Miscellaneous repair parts.....	75,759.26	64,852.19	58,934.63
34	Cableway repair parts.....	17,307.66	20,748.23	14,034.69
35	Track material, except track tools.....	105,712.19	189,947.04	82,329.46
36	Air compressor repair parts.....	3,906.47	4,654.88	2,816.58
37	Explosives, fuses, etc.....	25,056.93	143,063.68	53,886.81
38	Blasting batteries, galvanometers, and parts.....	1,181.09	3,381.69	3,760.43
39	Rough castings.....	169,614.99	131,967.83	113,957.65
40	Foundry supplies only.....	37,535.69	40,719.03	74,884.00
41	Miscellaneous machine parts.....	22,982.88	31,186.93	17,042.78
42	Miscellaneous material not carried at Mount Hope depot.....	62,313.95	61,578.37	37,183.38
43	Miscellaneous material carried at Mount Hope depot, not included in above classifications.....	2,453,799.67	1,816,286.50	1,672,441.78
	Total.....	4,511,781.46	3,721,212.90	3,436,995.69
	Net reduction in stock.....			284,217.21

EXHIBIT 18.—*Values of stock on hand at storehouses.*

Storehouses.	June 30, 1911.	June 30, 1912.	June 30, 1913.
Porto Bello.....	\$100,345.26	\$75,714.74	\$64,137.68
Toro Point.....	20,693.76	25,490.36	15,787.22
Cristobal shops.....	109,994.72	70,076.22	117,671.86
Dry dock store.....	250,755.65	194,906.69	192,967.64
Mount Hope depot.....	1,502,838.23	1,363,879.79	1,256,260.98
Gatun.....	338,035.71	271,610.16	170,998.60
Tabernilla.....	1,926.78		
Gorgona.....	841,072.54	644,748.91	406,310.37
Las Cascadas.....	15,265.12	10,772.80	9,804.15
Empire.....	936,037.25	773,052.38	747,512.51
Culebra.....	5,294.54	3,429.13	1,298.38
Pedro Miguel.....	30,633.03	24,664.81	34,994.55
Miraflores.....	138,239.60	101,929.77	94,153.63
Corozal.....	1,990.73	1,332.88	18,461.00
Ancon.....	10,766.40	16,003.08	13,772.98
Balboa.....	207,892.14	143,601.18	292,864.14
Total.....	4,511,781.46	3,721,212.90	3,436,995.69
Decrease in stock value as of June 30, 1913.....			284,217.21

EXHIBIT 19.—*Material returned to stock by departments and divisions July 1, 1912, to June 30, 1913.*

Atlantic division.....	\$109,284.42
Central division.....	171,086.01
Pacific division.....	67,810.43
Mechanical division.....	214,167.94
Chief engineer:	
First division.....	7,186.07
Second division.....	1,732.52
Fifth division.....	26,664.47
Sixth division.....	5,649.72
Lighthouse subdivision.....	40.00
Fortifications.....	4,149.08
Sanitary department.....	1,187.28
Subsistence department.....	167.29
Department of civil administration.....	350.89
Quartermaster's department.....	1,072.53
Old main line, Panama Railroad.....	8,605.36
Panama Railroad relocation.....	18,060.44
Miscellaneous.....	1,185.47
Total.....	638,399.92



## APPENDIX K.

### REPORT OF LIEUT. COL. EUGENE T. WILSON, UNITED STATES ARMY, SUBSISTENCE OFFICER, IN CHARGE OF SUBSISTENCE DEPARTMENT.

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#### ISTHMIAN CANAL COMMISSION, SUBSISTENCE DEPARTMENT, *Cristobal, Canal Zone, July 29, 1913.*

SIR: I have the honor to submit the following report covering the operations of the subsistence department for the fiscal year ended June 30, 1913:

The operation of the hotels, messes, and kitchens for the past year has continued under the direct charge of Capt. F. O. Whitlock, United States Cavalry, assistant subsistence officer.

On June 30, 1913, this department was operating the Hotel Tivoli, 17 line hotels, 3 night restaurants, 15 European laborers' messes, and 16 common laborers' kitchens—a decrease of 2 hotels, 3 messes, and 2 kitchens from last year. The hotel at Balboa was closed July 16 and consolidated with the hotel at Ancon, which was renamed "Balboa Hotel." The No. 2 Hotel at Gatun was closed March 31. The messes at Cerro, Haut Obispo, Gatun (No. 68), and Naos Island were closed during the year and one at Bas Obispo opened. A new kitchen was also opened at Bas Obispo, while those at Ancon, Cerro, and Haut Obispo were closed. The number of districts into which the territory served by this department is divided was reduced to 14, each in charge of a chief steward, reporting direct to the subsistence officer.

The total revenue for the year from the line hotels, restaurants, messes, and kitchens was \$1,235,077.84, a decrease of \$28,791.97 from last year, while the total cost of operations was \$1,205,800.76, a decrease of \$20,551.40, making the profit \$29,277.08, a decrease of \$8,240.57 from last year. The ratio of supplies consumed to revenue was 0.24 per cent less than last year, and of expense to revenue 0.84 per cent more, making the ratio of total cost of operations to revenue 0.60 per cent more than last year. The percentage of profit to revenue was 2.37 per cent, 0.60 per cent less than last year. The net expense for salaries and wages was \$166,398.65, an increase of \$4,391.88, making the proportion of net pay roll to revenue 13.47 per cent, 0.65 per cent more than last year.

The total number of meals served in line hotels was 2,340,644, an increase of 265,309 (12.78 per cent) over last year. The average cost of supplies per meal was 24.64 cents, a decrease of 0.40 cent from last year, while the average cost of service was 5.52 cents, a decrease of 0.09 cent, making a decrease in the total cost per meal of 0.49 cent from last year. The total number of rations served in European laborers' messes was 935,516, or 172,659 (15.58 per cent) less than last

year, while the average cost of supplies per ration was 31.27 cents, an increase of 0.21 cent, and the average cost of service was 5.86 cents, an increase of 0.39 cent, making an increase over last year in the total cost per ration of 0.60 cent. The total number of rations served in common laborers' kitchens was 461,456, a decrease from last year of 123,001 (21.05 per cent). The average cost of supplies per ration was 22.12 cents, an increase of 0.24 cent over last year, and the average cost of service was 3.52 cents, an increase of 0.31 cent, making the total cost per ration 25.64 cents, an increase over last year of 0.55 cent.

The average daily attendance during June, 1913, was 3,279 at the line hotels, 2,412 at the messes, and 1,229 at the kitchens. The attendance at the line hotels was determined on the basis that each guest averaged two meals per day.

The following table shows the relative value of food consumed per meal in the line hotels:

	Cents.
Meats and fish:	
Fresh.....	7.39
Canned.....	.13
Cured, and lard.....	1.87
Butter and oleo.....	2.12
Eggs.....	2.74
Fruits and vegetables:	
Fresh.....	3.73
Canned and jams.....	2.20
Dried.....	.31
Coffee, tea, and cocoa.....	.53
Milk.....	.69
Sugar and sirups.....	.74
Bread and cake.....	.99
Flour.....	.50
Ice cream.....	1.40
Miscellaneous.....	1.49
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	26.83

In addition, 2,025 pounds of ice were consumed which cost 0.81 cent.

The following table shows the relative value of the ration supplied the European laborers' messes:

	Cents.
Meats and fish:	
Fresh.....	13.31
Canned.....	.51
Cured, and lard.....	.30
Butter and oleo.....	.02
Fruits and vegetables:	
Fresh.....	1.31
Canned, and jams.....	.14
Dried.....	2.14
Coffee, tea, and cocoa.....	.74
Milk.....	.16
Sugar and sirups.....	1.30
Bread and cake.....	6.64
Flour.....	.14
Macaroni, spaghetti, and vermicelli.....	1.25
Pimenton and pomidoro.....	.38
Wine.....	2.44
Miscellaneous.....	.72
	<hr/>
	31.50

One and six-tenths pounds of ice, costing 0.64 cent, were also consumed.

The relative value of the ration supplied through the common laborers' kitchens is shown below:

	Cents.
Meats and fish:	
Fresh.....	8.51
Canned.....	.19
Cured, and lard.....	1.05
Butter and oleo.....	.05
Fruits and vegetables:	
Fresh.....	1.72
Canned, and jams.....	.54
Dried.....	.78
Coffee, tea, and cocoa.....	.55
Milk.....	.19
Sugar and sirups.....	1.32
Bread and cake.....	4.42
Flour.....	.40
Rice.....	1.72
Miscellaneous.....	.53
	21.97

The costs in the foregoing tables are approximate only, as they were made up by taking corresponding periods in each of the last 12 months and averaging them. The actual cost would be about 8 per cent less for the hotels and about 0.7 per cent less for the messes because discount has not been taken into consideration; consequently the above figures will not check with the figures mentioned elsewhere in this report. Elaborate meals, costing several times the regular meal, were served on special holidays.

The following table shows the quantities and gross costs of the principal articles consumed in the line hotels, restaurants, messes, and kitchens during the year:

Article.	Quantity.	Cost.	Article.	Quantity.	Cost.
Bacon.....pounds..	64,672	\$15,815.93	Lard.....pounds..	124,228	\$13,478.06
Beans, dried.....do..	187,721	10,787.46	Liver, beef.....do..	19,103	2,101.48
Beef:			Macaroni.....do..	187,360	13,153.25
Fresh.....do..	2,514,380	263,353.57	Maple sirup.....quarts..	7,702	2,428.88
Salt.....do..	42,008	5,077.98	Meats, canned.....tins..	23,989	4,571.06
Bones and suet.....do..	175,656	2,573.99	Milk.....do..	226,731	18,835.05
Bread.....do..	2,425,223	95,055.73	Mutton, fresh.....pounds..	39,801	4,430.79
Breakfast foods.....tins..	35,231	4,706.25	Oleomargarine.....do..	15,025	1,652.75
Butter.....pounds..	132,063	49,596.73	Onions.....do..	172,135	5,578.64
Cabbage.....do..	153,075	5,257.90	Peas, dried.....do..	94,880	5,866.86
Cake.....do..	13,492	1,478.81	Pork:		
Cheese.....do..	27,951	6,611.02	Fresh.....do..	166,865	26,468.54
Cocoa.....do..	25,691	3,539.65	Salt.....do..	4,823	650.07
Coffee.....do..	80,664	16,154.50	Potatoes:		
Corn meal.....do..	29,016	1,276.91	Sweet.....do..	191,422	4,578.93
Eggs.....dozen..	211,227	65,469.89	White.....do..	1,355,214	41,731.25
Fish:			Poultry.....do..	153,987	25,830.00
Canned.....tins..	30,460	3,724.03	Rice.....do..	433,567	13,011.18
Fresh.....pounds..	107,035	7,032.72	Rolls.....dozen..	37,541	8,741.28
Salt.....do..	34,333	2,884.50	Sausage.....pounds..	27,325	3,971.42
Flour.....do..	500,319	15,009.57	Sugar:		
Fruits:			Granulated.....do..	144,951	7,104.75
Canned.....tins..	74,325	2,027.76	Yellow.....do..	633,227	25,329.08
Dried.....pounds..	33,968	3,093.80	Tea.....do..	8,207	2,847.91
Fresh.....do..	31,171.92		Veal, fresh.....do..	72,651	11,009.15
Garbanzos.....pounds..	162,384	7,321.12	Vegetables:		
Ham.....do..	45,654	9,142.16	Canned.....tins..	165,566	25,594.74
Ice.....cwt..	66,081	26,432.60	Fresh.....do..		21,992.68
Ice cream.....gallons..	70,050	35,318.75	Wine.....barrels..	1,128	23,124.00
Jams.....do..		7,491.43	Cleaning.....do..		10,554.98
Lamb, fresh.....pounds..	35,894	4,693.98	Miscellaneous.....do..		50,248.16

The Hotel Tivoli installed a commercial laundry, which was opened in December, to handle the guests' work. The people from about 30 special tourist steamers, as well as other parties visiting the Isthmus, were satisfactorily served.

Below is given a comparative statement of the profits and losses of the Hotel Tivoli for the fiscal years ended June 30, 1911, 1912, and 1913:

Months.	1910-11		1911-12		1912-13	
	Profit.	Loss.	Profit.	Loss.	Profit.	Loss.
July.....	\$87.64		\$2,920.57		\$2,012.98	
August.....		\$1,727.86	1,433.34			\$1,513.16
September.....		710.81		\$1,582.19	99.35	
October.....		223.18	1,722.41		214.46	
November.....	2,771.76		2,682.78		4,081.96	
December.....	804.33		3,771.58		8,003.51	
January.....	2,964.78		7,122.72		13,587.71	
February.....	8,594.77		14,813.36		23,994.82	
March.....	8,193.02		13,876.32		18,826.74	
April.....	2,246.15		6,111.00		5,346.04	
May.....	2,307.30		59.34		2,422.36	
June.....	1,119.15		721.14			\$20.22
Net profit.....	26,427.05		53,652.36		76,256.55	

The following table shows quantities and gross values of the principal articles consumed at the Hotel Tivoli during the year:

Article.	Quantity.	Cost.	Article.	Quantity.	Cost.
Bacon.....pounds..	7,649	\$1,885.63	Lard.....pounds..	7,700	\$839.00
Beans, dried.....do..	250	15.50	Macaroni.....do...	799	55.93
Beef:			Maple sirup.....quarts..	1,416	450.72
Fresh.....do...	62,224	11,151.55	Meats, canned.....tins..	192	55.92
Salt.....do...	2,500	348.00	Milk.....do...	29,088	2,432.16
Bones and suet.....do..	861	4.31	Mutton, fresh.....pounds.	37,979	4,265.20
Bread.....do...	14,602	576.64	Oleomargarine.....do...	2,100	231.00
Breakfast foods.....tins..	1,350	220.82	Onions.....do...	9,054	289.27
Butter.....pounds..	16,906	6,466.34	Peas, dried.....do...	1,400	85.75
Cabbage.....do...	6,092	204.58	Pork:		
Cake.....do...	25	5.00	Fresh.....do...	8,093	1,346.35
Cheese.....do...	2,376	597.16	Salt.....do...	1,000	136.00
Cocoa.....do...	532	120.12	Potatoes:		
Coffee.....do...	5,455	1,364.75	Sweet.....do...	6,816	159.99
Corn meal.....do...	950	54.25	White.....do...	106,090	3,241.45
Eggs.....dozen...	21,060	6,567.30	Poultry.....do...	49,468	12,799.96
Fish:			Rice.....do...	12,865	710.37
Canned.....tins..	3,765	901.26	Sausage.....do...	1,989	334.48
Fresh.....pounds..	52,579	6,264.99	Sugar:		
Salt.....do...	3,765	425.98	Granulated.....do...	28,940	1,434.37
Flour.....do...	63,210	1,896.30	Yellow.....do...	4,542	181.68
Fruits:			Tea.....do...	864	265.62
Canned.....tins..	7,094	1,657.86	Veal, fresh.....do...	8,137	1,234.34
Dried.....pounds..	892	100.60	Vegetables:		
Fresh.....do...		6,862.43	Canned.....tins..	19,202	3,406.86
Ham.....pounds..	15,759	3,151.96	Fresh.....do...		5,771.00
Ice.....cwt.	13,462	5,384.80	Cleaning.....do...		1,653.29
Ice cream.....gallons.	2,544	2,574.00	Miscellaneous.....do...		11,323.96
Jams.....do...		486.24	Cigar stand and mineral waters		13,540.42
Lamb, fresh.....pounds.	2,368	317.18			

The following table shows the profit resulting from this department's operations for the year in comparison with the fiscal year ended June 30, 1912:

	1912-13		Increase.	Decrease.
	Profit.	Loss.		
Line hotels and restaurants.....		\$3,837.71	\$8,247.66	
European laborers' messes.....	\$26,845.24			\$11,610.54
Common laborers' kitchens.....	6,269.55			4,877.69
	29,277.08			8,240.57
Hotel Tivoli.....	76,256.55		22,604.19	
Total.....	105,533.63		14,363.62	

The original cost of the Hotel Tivoli was \$300,595.40. Additions and improvements have been made to the permanent building and bathrooms added since July 1, 1908, amounting to \$84,264.46, making the book value of the building \$384,859.86. The following table shows repairs to the Hotel Tivoli:

Prior to July 1, 1908.....	\$17,378.03
Fiscal year:	
1908-9.....	1,846.33
1909-10.....	2,377.76
1910-11.....	2,872.96
1911-12.....	313.67
1912-13.....	3,309.92
	28,098.67

making total construction and repairs to June 30, 1913, \$412,958.53. To this should be credited since July 1, 1908, profit on operations of \$170,298.14, making the Hotel Tivoli stand on the books, net, June 30, 1913, at \$242,660.39, and at the present rate of traffic the Hotel Tivoli should be amortized in about four years.

The total revenue of the subsistence department, Isthmian Canal Commission, from the operations of the hotels, messes, and kitchens and the Hotel Tivoli for the five years from July 1, 1908, to June 30, 1913, was \$7,493,887.59. The total revenue of the commissary department of the Panama Railroad Co., which is operated by the subsistence department, for the same period was \$30,287,222.74, making a grand total of \$37,781,110.33.

Tables showing details of the financial operations for the fiscal year are attached hereto.

Very respectfully,

EUGENE T. WILSON,  
Lieutenant Colonel, Coast Artillery Corps,  
United States Army, Subsistence Officer.

Col. GEORGE W. GOETHALS, United States Army,  
Chairman and Chief Engineer, Culebra, Canal Zone.

TABLE 1.—Statement of operations—Line hotels, restaurants, messes, and kitchens—July 1, 1912, to June 30, 1913.

	1912												Total.
	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	
Supplies on hand and in transit.....	\$17,391.79	\$17,778.15	\$17,859.53	\$18,972.19	\$19,566.15	\$17,428.33	\$17,929.54	\$19,487.97	\$21,023.17	\$19,372.51	\$18,450.60	\$19,307.84	\$224,587.77
Supplies purchased.....	88,861.74	87,093.98	87,524.55	93,310.25	89,030.99	94,332.49	96,785.53	89,327.53	93,654.52	92,901.77	95,881.24	85,931.02	1,095,235.61
Supplies from hotels, messes, and kitchens.....	45,165.32	42,448.27	40,389.44	41,676.05	39,650.82	37,936.46	39,176.12	36,347.50	38,962.98	37,888.00	37,954.75	34,962.56	472,528.27
Total debit supplies.....	151,418.85	147,920.40	145,773.52	153,958.49	148,267.96	149,697.28	153,891.19	145,163.00	153,640.67	150,122.28	152,286.59	140,201.42	1,792,351.65
Discounts allowed.....	6,884.13	6,794.29	6,806.53	7,229.22	6,917.13	7,232.02	7,420.18	6,867.95	7,171.34	7,080.83	7,273.67	5,283.49	82,930.80
Credit notes.....	235.95	352.87	328.44	554.89	409.34	253.08	345.15	414.52	331.64	384.30	534.88	237.50	4,392.56
Supplies to cleaning.....	825.12	823.73	759.61	790.46	835.87	905.96	914.19	852.42	882.82	880.89	988.70	952.25	10,412.02
Supplies to hotels, messes, and kitchens.....	45,165.32	42,448.27	40,389.44	41,676.05	39,650.82	37,942.96	39,186.44	36,377.13	38,968.48	37,864.25	37,954.75	34,934.56	472,558.47
Supplies on hand and in transit.....	17,778.15	17,859.53	18,972.19	19,586.15	17,428.33	17,929.54	19,487.97	21,023.17	19,372.51	18,450.60	19,307.84	17,079.39	224,275.37
Total credit supplies.....	70,908.67	68,278.69	67,256.21	69,836.77	65,241.49	64,263.56	67,353.93	65,535.19	66,716.79	64,630.87	66,059.86	58,487.19	794,569.22
Total supplies consumed.....	80,510.18	79,641.71	78,517.31	84,121.72	83,026.47	85,433.72	86,537.26	79,627.81	86,923.88	85,501.41	86,226.73	81,714.23	997,782.43
Supplies to cleaning.....	825.12	823.73	759.61	790.46	835.87	905.96	914.19	852.42	882.82	880.89	988.70	952.25	10,412.02
Pay roll:													
Proportion general force.....	2,075.17	1,919.06	2,893.26	2,089.86	2,883.99	2,114.60	2,589.65	2,018.23	1,935.10	2,067.85	2,435.70	2,161.84	27,184.31
Hotel, restaurant, mess, and kitchen help.....	10,678.86	10,620.04	11,115.92	11,146.49	11,248.00	11,242.58	11,429.14	12,163.03	12,477.62	12,612.25	12,573.01	12,349.84	139,656.78
Laundry.....	1,505.98	1,450.72	1,331.67	1,563.61	1,524.46	1,656.11	1,594.99	1,488.49	1,512.11	1,702.90	1,880.69	1,698.87	18,911.60
Fuel.....	591.99	591.99	591.99	591.99	591.99	591.99	591.99	591.99	591.99	591.99	591.99	591.99	7,103.88
Electric light and power.....	82.40	76.40	70.00	70.00	70.00	70.00	72.40	72.40	72.40	72.40	72.40	72.40	873.20
Equipment:													
Straight.....	229.07	308.85	191.01	154.39	267.28	189.06	441.44	392.27	318.76	319.68	291.12	144.65	3,247.68
Expendable.....	70.64	53.00	139.38	67.13	84.90	125.49	81.91	87.48	81.00	79.16	55.68	80.73	1,006.50
Launch service.....													60.00
Injury claims.....													89.39
Gross expense.....	16,069.23	15,843.89	17,092.84	16,534.93	17,506.49	16,932.30	17,733.42	17,674.81	17,871.80	18,327.12	18,889.29	18,079.24	208,545.36

Less pay-roll deductions (breakage).....	9.84	19.20	10.01	13.47	7.59	2.05	.41	5.02	.....	2.94	5.36	4.93	80.82
Less miscellaneous credits.....				194.31	25.66	52.13	32.14	27.85	31.85	.....	27.92	54.45	446.21
Total expense.....	16,049.39	15,824.69	17,082.83	16,327.15	17,473.24	16,878.12	17,700.87	17,641.94	17,839.95	18,324.18	18,856.11	18,019.86	208,018.33
Total cost of operation.....	96,559.57	95,466.40	95,600.14	100,448.87	100,490.71	102,311.84	104,238.13	97,269.75	104,763.83	103,825.59	105,082.84	99,734.09	1,205,800.76
Coupons and tickets.....	96,111.43	96,475.02	94,772.73	101,835.26	99,168.43	100,506.35	103,582.60	96,333.92	103,523.46	101,182.65	101,971.02	97,082.45	1,192,645.32
Mess kits.....							5.76	1,151.04					1,151.04
Cash.....	1,793.15	1,201.15	1,197.56	1,334.45	1,504.30	1,949.95	1,723.36	1,935.60	1,780.28	1,566.85	1,288.25	1,282.05	18,558.05
Sanitary department.....	1,806.29	1,334.13	1,273.11	1,317.40	1,321.99	249.76	232.07	173.84	173.61	173.59	220.36	202.19	3,002.34
Civil administration.....	1,891.84	1,839.26	1,869.66	1,869.66	1,969.31	1,950.61	1,362.26	862.56	882.99	710.73	766.44	806.49	16,808.06
Y. M. C. A.....	206.58	207.13	171.46	149.23	169.35	147.16	184.14	169.83	204.24	159.73	184.23	158.10	2,111.20
Chairman's office.....	2.10	2.70	3.60	2.40	1.20	1.80	.....	.30	2.40	1.20	.30	1.80	19.80
Second division chief engineer.....	4.80	.....	.....	.....	.....	.....	.....	.....	2.00	2.80	.....	.....	9.60
Panama Railroad Co.....	.....	92.57	.....	11.50	30.00	27.90	6.90	7.30	.....	.....	4.20	3.90	184.87
Quartermaster's department.....	.....	.....	20.50	.....	2.00	.....	5.33	.....	2.27	3.60	3.33	.....	37.03
First division chief engineer.....	.....	.....	.....	1.00	67.67	106.60	105.70	66.63	93.27	78.27	150.32	131.33	800.79
Construction and engineering.....	.....	.....	.....	31.87	10.27	.....	.....	.....	.....	.....	.....	.....	42.14
Atlantic division.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	85.20
Miscellaneous collections.....	59.70	25.50	155.40	48.30	30.60	17.10	43.77	42.34	99.95	93.58	69.10	31.30	716.64
Total revenue.....	100,375.89	100,197.46	98,471.17	105,600.99	103,275.12	104,957.23	107,271.89	99,745.36	106,764.47	104,031.80	104,685.95	99,700.51	1,235,077.84
Profit.....	3,816.32	4,731.06	2,871.03	5,152.12	2,775.41	2,645.39	3,033.76	2,475.61	2,000.64	206.21	.....	33.58	29,707.55
Loss.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	430.47
Net profit.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	29,277.08

TABLE 2.—Statement of operations—Line hotels and restaurants—July 1, 1912, to June 30, 1913.

	1912						1913						Total.
	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	
Supplies on hand and in transit.....	\$16,609.38	\$16,856.50	\$17,183.24	\$18,167.40	\$18,738.34	\$16,655.56	\$17,010.27	\$18,566.24	\$20,029.17	\$18,325.28	\$17,463.01	\$18,298.86	\$213,903.25
Supplies purchased.....	83,920.15	82,915.21	82,821.66	88,489.86	84,647.45	88,983.13	90,985.22	83,946.85	88,465.52	87,718.43	90,485.95	81,192.24	1,034,351.67
Supplies from hotels, messes, and kitchens.....	10,282.79	9,054.04	8,507.62	49,503.04	8,665.20	9,009.22	9,146.04	7,897.27	8,667.07	8,084.03	7,509.85	6,736.54	103,062.71
Debit supplies.....	110,812.32	108,825.75	108,512.52	116,160.30	112,080.99	114,647.91	117,151.53	110,410.36	117,161.76	114,127.74	115,458.81	106,227.64	1,351,547.63
Discounts allowed.....	5,952.80	5,848.11	5,958.29	6,328.18	6,086.84	6,336.48	6,477.31	6,029.02	6,406.45	6,301.45	6,494.49	4,838.61	73,058.03
Credit notes.....	329.72	352.87	328.44	554.89	394.91	250.29	334.68	380.59	381.18	232.51	516.04	232.51	4,270.45
Supplies to cleaning.....	500.05	530.83	499.44	511.83	575.36	600.82	599.23	547.21	559.93	571.78	667.03	630.33	6,793.84
Supplies to hotels, messes, and kitchens.....	43,003.15	40,653.40	38,898.12	40,189.30	38,351.20	36,393.86	37,333.28	34,588.86	36,893.49	35,462.60	35,632.11	32,810.67	450,842.04
Supplies on hand and in transit.....	16,856.50	17,183.24	18,167.40	18,738.34	16,655.56	17,010.27	18,566.24	20,029.17	18,325.28	17,463.01	18,298.86	16,079.95	213,373.82
Credit supplies.....	67,162.22	64,600.45	63,851.69	66,322.54	62,063.87	60,591.72	63,310.74	61,574.85	62,479.48	60,180.02	61,608.53	54,592.07	748,338.18
Supplies consumed.....	43,650.10	44,225.30	44,660.83	49,837.76	49,987.12	54,056.19	53,840.79	48,835.51	54,682.28	53,947.72	53,850.28	51,635.57	603,209.45
Supplies to cleaning.....	500.05	530.83	499.44	511.83	575.36	600.82	599.23	547.21	559.93	571.78	667.03	630.33	6,793.84
Injury claims.....							8.50						8.50
Pay roll:													
Proportion general force.....	1,118.52	1,057.21	1,038.03	1,227.59	1,686.57	1,302.01	1,579.95	1,206.92	1,197.66	1,275.32	1,499.42	1,318.29	16,105.49
Hotel help.....	7,080.09	7,153.30	7,586.14	7,671.97	7,681.18	7,876.75	7,970.90	8,465.71	8,875.84	8,975.42	8,866.50	8,784.79	96,990.59
Quartermaster's department, hotel help.....	1,369.29	1,337.62	1,227.51	1,428.26	1,387.25	1,524.53	1,469.54	1,368.80	1,398.22	1,579.96	1,756.61	1,582.87	4.18
Laundry.....				16.20						2.31			17,430.46
Launch service.....							11,619.62	11,597.14	12,031.65	12,404.79	12,780.56	12,316.28	137,346.26
Gross expense.....	10,067.95	10,080.96	10,949.12	10,855.85	11,332.23	11,304.11	28.36	27.85	31.85			54.45	442.43
Less miscellaneous credits.....				194.31	25.66	52.13							
Expense.....	10,067.95	10,080.96	10,949.12	10,661.54	11,306.57	11,251.98	11,591.26	11,569.29	11,999.80	12,404.79	12,761.74	12,261.83	136,906.83
Cost of operation.....	53,718.05	54,306.26	55,609.95	60,499.30	61,283.69	65,308.17	65,432.05	60,404.80	66,682.08	66,352.51	66,612.02	63,897.40	740,116.28
Coupons (30 cents).....	50,851.05	52,526.50	53,157.75	59,275.85	58,554.60	62,119.00	63,237.40	58,181.60	64,201.90	62,841.70	62,814.65	59,287.50	707,049.50
Cash.....	1,793.15	1,201.15	1,197.86	1,334.35	1,504.30	1,949.95	1,723.36	1,935.60	1,780.28	1,566.85	1,288.25	1,282.95	18,558.05
Sanitary department.....	26.40	20.80	15.20	31.20	8.13	8.46	22.41	15.12	16.74	16.20	16.74	16.20	213.60
Civil administration.....	1,171.21	1,159.60	1,149.61	1,172.70	1,085.96	1,064.11	433.64	7.29	8.37	7.65	7.56	7.02	7,274.72
Y. M. C. A.....	206.58	207.13	171.46	149.25	169.35	147.16	184.14	169.83	204.24	159.73	184.23	158.10	2,111.20
Chairman's office.....	2.10	33.90	3.60	2.40	1.20	1.80	6.90	7.30	2.40	1.20	4.20	1.80	19.80
Panama Railroad Co.....				11.50	30.00	27.90						3.50	126.20





TABLE 3.—Statement of operations—European laborers' messes—July 1, 1912, to June 30, 1913.

	1912						1913						Total.
	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	
Supplies on hand and in transit.....	\$752.41	\$921.65	\$676.29	\$804.79	\$847.81	\$772.77	\$919.27	\$921.73	\$994.00	\$1,047.23	\$987.59	\$1,008.98	\$10,684.52
Supplies purchased.....	4,941.59	4,778.77	4,702.89	4,820.39	4,383.54	5,349.36	5,790.31	5,380.68	5,189.00	5,183.34	5,385.29	4,738.78	60,653.94
Supplies from hotels, messes, and kitchens.....	25,397.07	23,980.48	22,847.91	23,559.98	22,667.28	21,194.37	21,805.63	19,720.26	21,769.98	21,641.84	22,207.07	20,284.98	267,076.86
Debit supplies.....	31,121.07	29,680.90	28,227.09	29,185.16	27,898.63	27,316.50	28,515.21	26,022.67	27,952.98	27,872.41	28,589.95	26,032.75	338,415.32
Discounts allowed.....	931.33	946.18	848.24	901.04	830.29	895.54	942.87	838.93	764.89	749.38	779.20	444.88	9,872.77
Credit notes.....	6.23	14.43	14.43	14.43	2.79	2.79	10.47	33.93	27.31	3.12	18.84	4.90	122.11
Supplies to cleaning.....	293.47	263.27	243.92	263.11	235.78	280.43	282.00	284.94	297.29	280.75	289.33	292.87	3,307.16
Supplies to hotels, messes, and kitchens.....	1,562.17	1,762.87	1,491.32	1,486.75	1,299.62	1,549.10	1,853.16	1,788.27	2,074.99	2,401.65	2,322.64	2,123.89	21,716.43
Supplies on hand and in transit.....	921.65	676.29	804.79	847.81	772.77	919.27	921.73	994.00	1,047.23	987.39	1,008.98	999.44	10,901.55
Credit supplies.....	3,714.85	3,648.61	3,388.27	3,498.71	3,152.89	3,647.13	4,010.23	3,940.07	4,211.71	4,422.49	4,418.99	3,866.07	45,920.02
Supplies consumed.....	27,406.22	26,032.29	24,838.82	25,686.45	24,745.74	23,669.37	24,504.98	22,082.60	23,741.27	23,449.92	24,170.96	22,166.68	292,495.30
Supplies to cleaning.....	293.47	263.27	243.92	263.11	235.78	280.43	282.00	284.94	297.29	280.75	289.33	292.87	3,307.16
Proportion general force.....	723.41	642.89	937.34	654.53	902.08	614.06	767.57	583.25	545.29	592.82	707.57	627.81	8,296.22
Mess help.....	2,718.84	2,630.67	2,682.03	2,637.80	2,701.76	2,550.38	2,639.85	2,707.56	2,655.91	2,719.99	2,772.18	2,602.54	32,019.51
Quartermaster's department—mess help.....	.....	.....	.....	.....	55	10.45	41	.....	.....	11.00	.....	.....	11.00
Correction on pay roll.....	108.55	87.51	79.17	107.08	108.81	102.40	89.25	87.58	82.50	90.20	96.89	92.59	1,132.53
Laundry.....	447.65	441.59	441.44	449.37	446.27	447.34	450.03	425.58	437.74	442.80	447.35	440.58	5,317.74
Fuel.....	66.40	60.50	55.00	55.60	55.70	56.50	59.20	55.00	57.80	58.60	59.40	55.80	696.10
Electric light and power.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Equipment.....	229.07	301.86	191.01	149.93	267.28	182.56	438.41	380.59	318.76	268.79	291.12	116.78	3,136.16
Straight.....	66.71	51.27	135.24	63.43	78.53	106.14	78.93	82.48	74.88	70.74	55.26	78.22	941.83
Expendable.....	.....	.....	.....	16.20	.....	.....	.....	.....	.....	.....	.....	.....	.....
Injury claims.....	.....	.....	.....	.....	.....	36.51	10.63	.....	.....	.....	.....	.....	47.14
Gross expense.....	4,654.10	4,479.56	4,765.15	4,397.05	4,797.36	4,386.77	4,816.28	4,007.58	4,470.17	4,524.69	4,719.10	4,307.19	54,995.00
Less pay roll deductions (breakage).....	7.16	11.45	7.08	9.08	5.03	1.60	3.78	5.02	.....	2.00	1.99	4.63	55.45
Less miscellaneous credits.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	3.78
Expense.....	4,646.94	4,468.11	4,758.07	4,387.97	4,792.33	4,385.17	4,812.09	4,002.56	4,470.17	4,522.69	4,717.11	4,302.56	54,865.77
Cost of operation.....	32,053.16	30,500.40	29,596.89	30,074.42	29,538.07	28,054.54	29,317.07	26,085.16	28,211.44	27,972.61	28,888.07	26,469.24	347,361.07

Tickets (40 cents, 27 cents, 13½ cents).....	34,725.07	33,243.47	31,511.13	32,793.87	31,310.80	29,908.27	31,206.54	28,435.47	29,953.73	29,354.27	30,198.13	28,779.47	371,480.22
Transfer tickets (13½ cents).....	737.20	468.00	328.73	318.40	429.60	484.13	498.93	300.80	322.80	381.77	481.07	774.00	5,586.39
Sanitary department.....	245.87	274.27	211.47	248.13	285.33	215.20	202.93	82.60	47.07	39.60	76.27	57.20	1,985.94
Second division, chief engineer.....	4.80	.....	.....	.....	.....	.....	.....	.....	2.00	2.80	.....	.....	9.60
Atlantic division.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	37.60	15.20	.....	52.80
Panama Railroad Co.....	58.67	.....	.....	.....	2.00	.....	5.33	.....	2.27	.....	3.33	.....	58.67
Quartermaster's department.....	.....	.....	.....	.....	38.27	61.60	59.20	28.53	45.87	35.07	93.47	78.53	16.53
First division, chief engineer.....	.....	.....	.....	31.87	10.27	.....	.....	.....	.....	.....	.....	.....	440.94
Construction and engineering.....	.....	.....	.....	.....	.....	.....	.....	12.07	37.20	24.67	21.73	23.20	42.14
Hospital farm.....	35,712.94	34,044.41	32,052.33	33,392.67	32,076.27	30,669.20	32,032.93	28,920.07	30,410.94	29,879.24	30,889.20	29,712.40	119.47
Gross revenue.....	737.20	468.00	329.73	318.40	429.60	484.13	498.93	360.80	322.80	381.73	481.07	774.00	379,792.70
Less transfer tickets (13½ cents).....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	5,586.39
Revenue.....	34,975.74	33,576.41	31,722.60	33,074.27	31,646.67	30,185.07	31,534.00	28,559.27	30,088.14	29,497.61	30,408.13	28,938.40	374,206.31
Profit.....	2,922.58	3,076.01	2,125.71	2,999.85	2,108.60	2,130.53	2,216.93	1,874.11	1,876.70	1,525.00	1,520.06	2,469.16	26,845.24
Rations served.....	87,439	83,941	79,307	82,686	79,117	75,463	78,835	71,398	75,220	73,744	76,020	72,346	935,516
Cost supplies per ration.....cents.....	31.34	31.01	31.32	31.06	31.28	31.37	31.08	30.93	31.56	31.80	31.80	30.64	31.27
Cost service per ration.....do.....	5.32	5.33	6.00	5.31	6.05	5.81	6.11	6.45	5.95	6.13	6.20	5.95	5.86
Total cost per ration.....do.....	36.66	36.34	37.32	36.37	37.33	37.18	37.19	37.38	37.51	37.93	38.00	36.59	37.13

TABLE 4.—Statement of operations—Common laborers' kitchens—July 1, 1912, to June 30, 1913.

	1912							1913.					Total.
	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	
Supplies from hotels, messes, and kitchens	\$9,435.46	\$9,413.75	\$9,033.91	\$8,613.03	\$8,318.34	\$7,732.87	\$8,224.45	\$8,729.97	\$8,523.93	\$8,132.13	\$8,237.83	\$7,941.03	\$102,388.70
Supplies to cleaning.....	31.60	29.03	16.25	15.52	24.73	24.71	32.96	20.27	25.60	28.36	32.34	29.05	311.02
Supplies consumed.....	9,433.86	9,384.12	9,017.66	8,597.51	8,293.61	7,708.16	8,191.49	8,709.70	8,500.33	8,103.77	8,205.49	7,911.98	102,077.68
Supplies to cleaning.....	31.60	29.03	16.25	15.52	24.73	24.71	32.96	20.27	25.60	28.36	32.34	29.05	311.02
Pay roll:													
Proportion general force.....	233.24	218.96	319.89	207.74	294.74	198.53	242.13	228.06	192.15	199.71	228.71	215.74	2,779.66
Kitchen help.....	879.93	834.07	847.75	836.72	862.64	805.00	817.98	989.76	945.87	914.53	934.33	962.51	10,631.09
Laundry.....	28.14	25.59	24.99	29.27	28.40	29.18	36.20	32.11	31.39	32.74	27.19	23.41	338.61
Fuel.....	144.34	150.40	150.55	142.62	145.72	144.65	141.96	166.41	154.25	149.19	144.64	151.41	1,786.14
Electric light and power.....	16.00	15.90	15.00	14.40	14.30	13.50	13.20	16.80	14.60	13.80	13.00	16.60	177.10
Injury claims.....							7.08					26.67	33.75
Equipment:													
Straight.....		7.09		4.46		6.50	3.03	11.68		50.89		27.87	111.52
Expendable.....	3.93	1.73	4.14	3.70	6.37	19.35	2.98	5.00	6.12	8.42	.42	2.51	64.67
Launch service.....	1,337.18	1,283.37	1,378.57	1,282.03	1,376.90	1,241.42	1,297.62	1,470.09	1,369.98	1,397.64	1,390.63	1,455.77	16,271.10
Gross expense.....	2.68	7.75	2.93	4.39	2.56	.45				.94	3.37	.30	25.37
Less pay roll deductions (breakage).....													
Expense.....	1,334.50	1,275.62	1,375.64	1,277.64	1,374.34	1,240.97	1,297.52	1,470.09	1,369.98	1,396.70	1,377.26	1,455.47	16,245.73
Cost of operation.....	10,788.36	10,659.74	10,393.30	9,875.15	9,667.95	8,949.13	9,489.01	10,179.79	9,870.31	9,500.47	9,582.75	9,367.45	118,323.41
Tickets (27 cents, 9 cents).....	10,535.31	10,705.05	10,103.85	9,765.54	9,303.03	8,479.08	9,078.66	9,716.85	9,367.83	8,986.68	8,958.24	9,015.48	114,015.60
Transfer tickets (9 cents).....	40.77	38.97	34.56	55.35	61.11	64.35	56.31	76.23	64.62	46.89	51.48	65.16	694.80
Mess kits (32 cents).....							5.76	151.04					156.80
Sanitary department.....	34.02	39.06	46.44	38.07	28.53	26.10	26.73	78.12	109.80	119.79	127.35	128.79	802.80
Civil administration.....	720.63	699.66	726.30	696.96	883.35	886.50	928.62	855.27	874.62	703.08	758.88	799.47	9,533.34
Hospital farm.....							13.77	21.87	16.65	14.31	8.37	8.10	83.07
First division, chief engineer.....											1.35		1.35
Gross revenue.....	11,330.73	11,482.74	10,911.15	10,555.92	10,276.02	9,456.03	10,148.55	10,899.38	10,433.52	9,870.75	9,905.67	10,017.00	125,287.76
Less transfer tickets (9 cents).....	40.77	38.97	34.56	55.35	61.11	64.35	95.31	76.23	64.62	46.89	51.48	65.16	694.80
Revenue.....	11,289.96	11,443.77	10,876.59	10,500.57	10,214.91	9,391.68	10,053.54	10,823.15	10,368.90	9,823.86	9,854.19	9,951.84	124,592.96
Profit.....	501.60	784.03	483.29	625.42	546.96	442.55	564.53	643.36	498.59	323.39	271.44	584.39	6,269.55
Rations served.....	41,815	42,384	40,284	38,891	37,833	34,784	37,235	40,086	38,403	36,385	36,497	36,859	461,456
Cost per ration.....	22.61	22.14	22.39	22.11	21.92	22.16	22.00	21.73	22.13	22.27	22.48	21.46	22.12
Cost service per ration.....	3.19	3.01	3.41	3.28	3.63	3.57	3.48	3.66	3.57	3.84	3.78	3.95	3.52
Total cost per ration.....	25.80	25.15	25.80	25.39	25.55	25.73	25.48	25.39	25.70	26.11	26.26	25.41	25.64

TABLE 5.—Statement of operations—Hotel Tivoli—July 1, 1912, to June 30, 1913.

	1912						1913						Total.
	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	
Supplies on hand and in transit.....	\$2,385.58	\$2,812.45	\$3,311.20	\$3,568.80	\$3,341.33	\$3,497.45	\$4,161.88	\$4,699.57	\$5,801.75	\$4,905.72	\$4,122.67	\$3,773.07	\$47,381.47
Supplies purchased.....	6,342.41	6,813.80	7,007.39	6,321.61	8,315.20	10,463.51	15,303.89	19,696.16	18,425.71	10,726.80	8,976.10	7,404.05	125,850.63
Supplies from hotels, messes, and kitchens.....						6.50	12.00	29.63	5.50	6.25			59.88
Supplies from quartermaster's department.....						129.48	17.50	134.84	96.65	53.17	33.18	4.45	469.27
Debit supplies.....	9,727.99	9,626.25	10,318.59	9,890.41	11,656.53	14,096.94	19,495.27	24,554.20	24,329.61	15,691.94	13,131.95	11,241.57	173,761.25
Discounts allowed.....	408.24	427.58	436.50	409.80	547.03	657.87	979.61	1,309.65	1,164.94	658.64	573.54	456.46	8,029.86
Credit notes.....		24.33			2.23				10.00				36.56
Supplies to cleaning.....	65.87	58.73	54.46	62.93	62.76	76.73	77.23	86.45	108.91	66.77	64.33	59.21	844.38
Supplies to quarters.....	161.68	165.14	166.61	151.45	160.44	170.76	205.99	280.27	370.34	283.91	268.62	222.06	2,607.27
Supplies to laundry.....							10.50				30.60	28.90	70.00
Supplies to hotels, messes, and kitchens.....							1.68					28.00	29.68
Supplies on hand and in transit.....	2,812.45	3,311.20	3,568.80	3,341.33	3,497.45	4,161.88	4,699.57	5,801.75	4,905.72	4,122.67	3,773.07	3,665.39	47,661.28
Credit supplies.....	3,448.24	3,986.98	4,226.37	3,965.51	4,269.91	5,067.24	5,974.58	7,478.12	6,559.91	5,139.99	4,710.16	4,460.02	59,279.03
Supplies consumed.....	6,279.75	5,639.27	6,092.22	5,924.90	7,386.62	9,029.70	13,520.69	17,076.08	17,769.70	10,559.95	8,421.79	6,781.55	114,482.22
Supplies to cleaning.....	65.87	58.73	54.46	62.93	62.76	76.73	77.23	86.45	108.91	66.77	64.33	59.21	844.38
Supplies to quarters.....	161.68	165.14	166.61	151.45	160.44	170.76	205.99	280.27	370.34	283.91	268.62	222.06	2,607.27
Supplies to laundry.....							10.50				30.60	28.90	70.00
Pay roll:													
Proportion general force.....	203.91	139.68	215.31	181.10	234.70	289.62	396.60	589.03	585.29	342.41	209.60	176.50	3,563.75
Hotel help.....	2,518.07	3,219.67	2,765.02	3,125.27	3,076.39	3,348.44	4,118.43	4,862.00	4,599.40	3,969.61	3,421.16	4,006.90	43,390.36
Laundry.....	684.45	577.28	626.22	680.78	679.03	725.81	833.60	1,130.56	1,124.11	943.69	963.00	440.88	9,009.41
Fuel.....	229.93	253.62	140.12	170.55	221.84	269.76	244.47	276.31	290.19	284.03	285.77	258.29	2,924.88
Electric light and power.....	194.64	160.32	187.16	209.72	218.52	283.72	340.12	348.76	381.28	262.92	228.36	320.48	3,136.00
Equipment:													
Straight.....	338.21	1,904.90	1,371.45	1,398.61	732.49	2,361.98	3,747.50	559.19	478.25	685.61	96.60	166.30	13,841.09
Expendable.....	155.05	396.78	273.66	283.01	283.01	399.55	309.44	373.64	343.71	215.81	268.23	101.34	3,288.79
Stationery.....	84.17	69.39	30.93	96.62	12.91	124.24	141.21	171.54	149.63	76.06	59.93	70.82	1,087.45
Telephone:													
Panama Telephone Co.....	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	1,200.00
Isthmian Canal Commission.....	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	1,200.00
Expense vouchers, cashier.....	10.40	11.00	9.80	10.60	10.20	10.40	10.80	9.40	10.60	10.40	10.40	10.00	124.00
Baggage transfer.....	75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00	900.00
Miscellaneous.....	8.30	22.45	16.10	18.20	68.30	92.10	4.65	40.80	32.45	51.15	40.20	93.95	488.65
Gross expense.....	4,819.68	7,163.96	6,041.84	6,463.40	5,945.59	8,334.11	10,645.54	8,912.95	9,019.16	7,377.37	5,731.80	6,140.63	86,596.03

TABLE 5.—Statement of operations—Hotel Tivoli—July 1, 1912, to June 30, 1913—Continued.

	1912						1913						Total.
	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	
Less pay roll deductions (breakage).....	\$1.20	\$0.94	\$1.07	\$1.59	\$11.81	\$1.17	\$9.37	\$10.49	\$7.54	\$2.14	\$1.24	\$0.76	\$49.32
Less miscellaneous credits.....		.50										300.00	300.50
Expense.....	4,818.48	7,162.52	6,040.77	6,461.81	5,933.78	8,332.94	10,636.17	8,902.46	9,011.62	7,375.23	5,730.56	5,839.87	\$6,246.21
Cost of operation.....	11,098.23	12,801.79	12,132.99	12,386.71	13,320.40	17,362.64	24,156.86	25,978.54	26,791.32	17,935.18	14,152.35	12,621.42	200,728.43
Cash.....	13,299.70	9,748.95	11,671.59	12,343.37	14,727.26	22,307.78	36,532.52	46,730.51	47,250.68	23,512.24	16,097.04	12,540.89	266,762.53
Coupons (30 cents).....	749.40	354.90	542.10	416.40	560.10	582.90	619.20	633.60	651.30	461.70	394.80	403.20	6,369.60
D. O. collections.....	175.76	275.98	359.45	224.70	691.45	278.87	420.60	480.35	1,356.38	192.93	220.87	322.51	4,999.85
Outstanding accounts.....	1,113.65	908.80	1,340.80	1,383.30	1,423.55	2,196.60	172.25	2,128.90	13,650.30	1,885.65	1,138.00	1,465.40	1,147.00
Revenue.....	13,111.21	11,288.63	12,232.34	12,601.17	17,402.36	25,366.15	37,744.57	49,972.36	45,608.06	23,281.22	16,574.71	11,801.20	276,984.98
Subsistence profit.....													28,810.26
Subsistence loss.....	135.64	1,249.04	1,202.27	1,834.97	689.07	2,326.17	6,388.60	11,496.21	7,569.13	341.08	881.01	2,224.96	7,527.89
Cigar-stand profit.....	282.35	317.01	274.45	349.73	392.18	562.76	906.08	1,657.57	1,060.23	576.30	377.49	228.46	6,984.61
Quarters profit.....	1,866.27		1,027.17	1,699.70	3,000.71	7,300.00	7,291.11	10,327.01	9,578.69	4,477.96	2,935.03	958.13	50,461.78
Quarters loss.....		581.13							618.69				581.13
Laundry profit.....							998.08	514.03				218.15	1,350.87
Laundry loss.....						2,185.42				49.30	9.15		3,241.95
Profit.....	2,012.98		99.35	214.46	4,081.96	8,003.51	13,587.71	23,994.82	18,826.74	5,345.04	2,422.36	820.22	78,580.93
Loss.....		1,513.10											2,333.38
Net profit.....													76,256.55
Meals served.....	10,533	8,570	9,311	9,560	12,350	17,243	25,312	33,733	31,852	16,531	11,802	9,044	195,841
Cost supplies per meal.....	53.94	62.29	60.63	57.12	54.50	46.79	48.24	45.02	48.67	57.90	65.61	70.19	52.84
Cost service per meal.....	21.23	30.87	27.10	36.22	20.41	15.66	15.83	12.51	13.48	21.38	20.11	32.26	19.12
Total cost per meal.....	75.17	93.16	87.73	93.34	74.91	62.47	64.07	57.53	62.15	79.28	85.72	102.45	71.96

1 Credit: This amount is preceding month's excess over current month.

TABLE 6.—Summary of operations, July 1, 1912, to June 30, 1913.

	Supplies consumed.	Laundry.	Pay roll.		Miscellaneous.	Fuel.	Light.	Equipment.		Total cost of operations.	Cash.	Coupons and tickets.	Collections.	Total revenue.	Profit.	Loss.	Meals served.	Rations served.
			General force.	Line gold and silver.				Straight.	Expendable.									
Line hotels and restaurants.																		
1912—July.....	\$43,650.10	\$1,369.29	\$1,118.52	\$7,080.09	\$500.05					\$53,718.05	\$1,793.15	\$50,851.05	\$1,465.99	\$54,110.19	\$392.14		168,012	
August.....	44,225.30	1,337.62	1,057.21	7,155.30	530.83					54,306.26	1,201.15	52,526.50	1,449.63	55,177.28	871.02		173,145	
September.....	44,660.83	1,227.51	1,636.03	7,586.14	499.44					55,609.95	1,197.86	53,157.75	1,516.34	55,871.98	262.03		175,547	
October.....	49,837.76	1,428.26	1,033.28	7,671.97	528.03					60,499.30	1,334.35	59,275.85	1,415.95	62,026.15	1,526.85		195,133	
November.....	49,987.12	1,387.25	1,660.91	7,683.05	575.36					61,293.69	1,504.30	58,554.60	1,354.64	61,413.54	119.85		193,002	
December.....	54,056.19	1,524.53	1,249.88	7,876.75	600.82					65,308.17	1,949.95	62,119.00	1,311.53	65,380.48	72.31		206,173	
1913—January.....	53,840.79	1,469.54	1,552.01	7,970.48	599.23					65,432.05	1,723.36	63,237.40	1,233.59	65,684.35	252.30		209,697	
February.....	48,835.51	1,368.80	1,179.07	8,465.71	555.71					60,404.80	1,935.60	58,181.60	1,245.74	60,362.94		\$41.86	192,996	
March.....	54,682.28	1,398.22	1,167.11	8,874.54	559.93					66,682.08	1,780.28	64,201.90	1,325.25	66,307.43		374.65	213,026	
April.....	53,947.72	1,579.96	1,275.32	8,977.73	571.78					66,352.51	1,566.75	62,841.70	1,301.78	64,710.33		1,642.18	208,745	
May.....	53,850.28	1,756.61	1,471.60	8,866.50	667.03					66,612.02	1,288.25	62,814.65	1,320.73	64,423.63		2,188.39	208,417	
June.....	51,635.57	1,582.87	1,264.76	8,783.87	630.33					63,897.40	1,282.95	59,287.50	1,239.82	60,810.27		3,087.13	196,751	
Total.....	603,209.45	17,430.46	15,665.70	96,992.13	6,818.54					740,116.28	18,558.05	707,049.50	10,671.02	736,278.57		3,837.71	2,340,644	
European laborers' messes.																		
1912—July.....	27,400.22	108.55	723.41	2,718.84	293.47	\$447.65	\$66.40	\$221.91	\$66.71	32,053.16		34,725.07	250.67	34,975.74	2,922.58			87,439
August.....	26,032.29	87.51	642.89	2,630.67	263.27	441.59	60.50	290.41	51.27	30,500.40		33,243.47	332.94	33,576.41	3,076.01			83,941
September.....	24,838.82	79.17	937.34	2,682.03	243.92	441.44	55.00	183.93	135.24	29,596.89		31,511.13	211.47	31,722.60	2,125.71			79,307
October.....	25,686.45	107.08	654.53	2,637.80	279.31	449.37	55.60	140.85	63.43	30,074.42		32,793.87	280.40	33,074.27	2,999.85			82,686
November.....	24,745.74	108.81	902.68	2,702.31	235.78	446.27	55.70	262.25	78.53	29,538.07		31,310.80	335.87	31,646.67	2,108.60			79,117
December.....	23,669.37	102.40	614.06	2,560.83	316.94	447.34	56.50	180.96	106.14	28,054.54		29,908.27	276.80	30,185.07	2,130.53			75,463
1913—January.....	24,504.98	89.25	767.57	2,640.26	292.63	450.03	59.20	434.22	78.93	29,317.07		31,266.54	267.46	31,534.00	2,216.93			78,835
February.....	22,002.60	87.58	583.25	2,707.56	284.94	425.58	55.60	375.57	82.48	26,685.16		28,435.47	123.80	28,559.27	1,874.11			71,398
March.....	23,741.27	82.50	545.29	2,655.91	297.29	437.74	57.80	318.76	74.88	28,211.44		29,953.73	134.41	30,088.14	1,876.70			75,220
April.....	23,449.92	90.20	592.82	2,719.99	280.75	442.80	58.60	266.79	70.74	27,072.61		29,354.27	143.34	29,497.61	1,525.00			73,744
May.....	24,170.96	96.89	707.57	2,772.18	289.33	447.35	59.40	289.13	55.26	28,888.07		30,198.13	210.00	30,408.13	1,520.06			76,020
June.....	22,166.68	92.59	627.81	2,602.54	292.87	440.58	55.80	112.15	78.22	26,469.24		28,779.47	158.93	28,938.40	2,469.16			72,346
Total.....	292,495.30	1,132.53	8,299.22	32,030.92	3,370.50	5,317.74	696.10	3,076.93	941.83	347,361.07		371,480.22	2,726.09	374,206.31	26,845.24			935,516
Common laborers' kitchen.																		
1912—July.....	9,453.86	28.14	233.24	879.93	31.60	144.34	16.00	2.68	3.93	10,788.36		10,535.31	754.65	11,289.96	501.60			41,815
August.....	9,384.12	25.59	218.96	834.07	29.63	150.40	15.90	1.66	1.73	10,659.74		10,705.05	738.72	11,443.77	784.03			42,384
September.....	9,017.66	24.99	319.89	847.75	16.25	150.55	15.00	2.93	4.14	10,393.30		10,103.85	772.74	10,876.59	483.29			40,284
October.....	8,597.51	29.27	207.74	836.72	43.12	142.62	14.40	.07	3.70	9,875.15		9,765.54	735.03	10,500.57	625.42			38,891
November.....	8,293.61	28.40	294.74	862.64	24.73	145.72	14.30	2.56	6.37	9,667.95		9,303.03	911.88	10,214.91	546.96			37,833
December.....	7,708.16	29.18	198.53	805.00	24.71	144.65	13.50	6.05	19.35	8,949.13		8,479.08	912.60	9,391.68	442.55			34,784
1913—January.....	8,191.49	36.20	242.13	817.98	40.04	141.96	13.20	3.03	2.98	9,489.01		9,084.42	969.12	10,053.54	564.53			37,235
February.....	8,709.70	32.11	228.06	989.76	20.37	166.41	16.80	11.68	5.00	10,179.79		9,867.89	955.26	10,823.15	443.36			40,086
March.....	8,500.33	31.39	192.15	945.87	25.60	154.25	14.60	6.12	9.870.31	9,870.31		9,367.83	1,001.07	10,368.90	498.59			38,403
April.....	8,103.77	32.74	199.71	914.53	28.36	149.19	13.80	49.95	8.42	9,500.47		8,956.68	837.18	9,823.86	323.39			36,385
May.....	8,205.49	27.19	228.71	934.33	32.34	144.64	13.00	3.37	.42	9,582.75		8,958.24	895.95	9,854.19	271.44			36,497
June.....	7,911.98	23.41	215.74	962.51	55.72	151.41	16.60	27.57	2.51	9,367.45		9,015.48	936.33	9,951.84	584.39			36,359
Total.....	102,077.68	348.61	2,779.60	10,631.09	372.37	1,786.14	177.10	86.15	64.67	118,323.41		114,172.40	10,420.56	124,592.96	6,269.55			461,456
Grand total.....	997,782.43	18,911.60	26,744.32	139,654.14	10,561.41	7,103.88	873.20	3,163.08	1,006.50	1,205,900.76	18,558.05	1,192,702.12	23,817.67	1,235,077.84	29,277.08		2,340,644	1,396,972





TABLE 7.—Summary of operations, Hotel Tivoli, July 1, 1912, to June 30, 1913.

	Supplies consumed.	Laundry.	Pay roll.		Miscellaneous.	Fuel.	Light.	Equipment.		Total cost of operation.	Cash.	Contingents.	D. O. collections.	Accounts.	Total revenue.	Profit.	Loss.	Meals served.
			General force.	Line gold and silver.				Straight.	Expendable.									
1912.																		
July.....	\$6,279.75	\$664.45	\$203.91	\$2,518.07	\$515.42	\$229.93	\$194.64	\$337.01	\$155.05	\$11,098.23	\$13,299.70	\$749.40	\$175.76	\$1,113.65	\$13,111.21	\$2,012.98	\$1,513.16	10,533
August.....	5,639.27	577.28	139.68	3,219.17	511.71	253.62	160.32	1,903.96	396.78	12,801.79	9,748.95	354.90	273.98	908.80	11,288.63	.....	.....	8,570
September...	6,092.22	626.22	215.31	2,765.02	462.90	140.12	187.16	1,370.98	273.66	12,132.99	11,671.59	542.10	359.45	1,340.80	12,232.34	.....	.....	9,511
October.....	5,924.90	680.78	181.10	3,125.27	524.80	170.55	209.72	1,397.02	172.57	12,386.71	12,343.37	416.40	224.70	1,383.30	12,601.17	.....	.....	9,560
November...	7,386.62	679.03	294.70	3,076.39	499.61	221.84	218.52	720.68	283.01	13,320.40	14,727.26	560.10	691.45	1,423.55	17,402.36	.....	.....	12,350
December...	9,029.70	725.81	289.62	3,348.44	659.23	269.76	283.72	2,360.81	395.55	17,362.64	22,307.78	582.90	278.87	2,196.60	25,366.15	.....	.....	17,243
1913.																		
January.....	13,520.69	853.60	396.60	4,118.43	635.38	244.47	340.12	3,738.13	309.44	24,156.86	36,532.52	619.20	420.60	172.25	37,744.57	13,587.71	.....	25,212
February...	17,076.08	1,130.56	589.03	4,862.00	773.46	276.31	348.76	548.70	373.64	25,978.54	46,730.51	633.60	480.35	2,128.90	49,973.36	23,994.52	.....	33,733
March.....	17,769.70	1,124.11	585.29	4,959.40	856.93	290.19	381.28	470.71	343.71	26,781.32	47,250.68	651.30	1,356.38	3,650.30	45,608.06	18,826.74	.....	31,852
April.....	10,559.95	943.69	342.41	3,969.61	673.29	284.03	262.92	683.47	215.81	17,935.18	23,512.24	461.70	192.93	1,885.65	23,281.22	5,346.04	.....	16,531
May.....	8,421.79	563.00	209.60	3,421.16	659.08	285.77	228.36	95.36	268.23	14,152.35	16,097.04	394.80	220.87	1,138.00	16,574.71	2,422.36	.....	11,802
June.....	6,781.55	440.88	176.50	4,006.90	669.94	285.29	320.48	2,134.46	101.34	12,621.42	12,540.89	403.20	322.51	1,465.40	11,801.20	.....	820.22	9,044
Total.....	114,482.22	9,009.41	3,563.75	13,389.86	7,441.75	2,924.88	3,136.00	13,491.77	3,288.79	200,728.43	266,762.53	6,369.60	4,999.85	1,147.00	276,984.98	76,256.55	.....	195,841

1 Credit: This amount is preceding month's excess over current month.

2 Credit: This amount, plus current month's charge, collected for breakage or equipment returned.



## APPENDIX L.

### REPORT OF H. A. A. SMITH, EXAMINER OF ACCOUNTS.

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ISTHMIAN CANAL COMMISSION,  
*Empire, Canal Zone, August 20, 1913.*

SIR: I have the honor to submit the following report of the transactions of the department of examination of accounts, including the duties performed as auditor of the Canal Zone Government, for the fiscal year ended June 30, 1913.

The general character of the business of this office and the organization through which it is handled has been sufficiently described in preceding reports. To the several divisions of general accounting, pay rolls, vouchers, coupon books and meal tickets, files and bonds, injury claims, contract laborers, time inspection, Canal Zone accounts, and inspection of accountable officers, a division of time-keeping was added during the latter half of the fiscal year, and on the 1st day of May the responsibility of the various clerks in the pay rolls and voucher divisions was increased to some extent.

This increased responsibility resulted from the reduction of the force in the disbursing office and the necessary elimination of a greater part of the duplicate detailed check made by that office of every voucher, pay roll, and pay receipt after those papers had been fully examined and checked on behalf of the commission by the force of this office, and the propriety of the proposed payments and the correctness of all rates, extensions, and totals determined.

Prior to October 1, 1908, the disbursing officer of the commission not only made disbursements and was responsible for the proper handling of cash, but he also had charge of the general books of the commission and performed many other duties not directly connected with the disbursement of funds. On that date the miscellaneous work performed by the disbursing officer was transferred to this office, except that property accounting was transferred to the quartermaster's department. The disbursing officer, insisting that he should make the same examination of pay rolls and vouchers he had made before for his own personal protection, was allowed a large force for the purpose, although the change as a whole resulted in a substantial reduction in expense and more satisfactory handling.

In the legislative, executive, and judicial appropriation act approved August 23, 1912, a provision was inserted relative to the administrative examination of public accounts and stating that "disbursing officers shall make only such examination of vouchers as may be necessary to ascertain whether they represent legal claims against the United States." Full consideration was given as to the meaning of this provision and its effect was discussed with the Appropriation

Committee of the House. As a result instructions were issued to the disbursing officer and to the examiner of accounts, which put this provision into effect May 1, 1913. This did not materially change the work of this office, but it did reduce the work and force in the disbursing office.

A timekeeping division was organized January 1 by consolidating the timekeeping, or rather the work of preparing time and pay rolls, for the chairman and chief engineer's office, the quartermaster's department, and the departments of civil administration and sanitation. Subsequently, similar work for the Atlantic and mechanical divisions was taken over and remained under the jurisdiction of this office until the end of the fiscal year. The work was not under this office for a sufficient time to fully systematize it. Besides, the consolidation was attempted at a time when it seemed inadvisable to make any radical changes in methods in view of the short time remaining before completion of a large part of the construction work. However, a material reduction in cost was the result of the consolidation. The force at work remained as large as ever, although it was shifting during the period from one division to another. From the best figures available the pay roll cost per man was \$0.259, whereas the average cost to the separate divisions previously was \$0.291. The total amount paid to the men assigned to the timekeeping division, either regularly or through temporary details, amounted to \$34,922.75 for the six months' period, including payments to several who left the service with from 60 to over 90 days accrued leave due, the maximum amount, \$8,733.01, being paid in the month of June. The total number of names carried on the rolls prepared under the supervision of this office during the month of June was 32,463, as against 43,335 on the rolls of the commission.

I have always been convinced and still am convinced that the pay-roll work can be more satisfactorily, economically, and safely administered under the jurisdiction of this office than anywhere else, on account of the fact that this office must necessarily be most familiar with the methods of handling the work. At the same time proper supervision of the work involved a heavy burden of which, on July 1, I was glad to be relieved. For the permanent organization the accounting office is the proper place to handle this work.

No change was made in the accounting system of the commission during the year with the exception that the classified expenditure accounts have been extended from time to time to provide for new operations of the commission, including the construction of new buildings, the electric transmission line, clearing the lake, etc., and a further separation of the accounts for the construction and maintenance of waterworks and sewers to care for the permanent water supply. Authority was given to close the material and supply account at the end of the fiscal year and to open a new account beginning July 1 in order to provide a more exact record of material and supplies on hand and issued. Plans were also made for providing, effective July 1, a method for more accurately determining the status of appropriations and especially the amount of outstanding obligations at any given time. This will involve considerable detail but it is essential at this stage of the construction work that accurate records on this subject be maintained. One change that will soon have to be made in the

accounting system is the opening of revenue accounts separate and distinct from the expenditure accounts. Heretofore the expenditure accounts have received credit for all revenues. In view of the character of the receipts this method of handling has not been entirely incorrect, but good accounting requires a distinct series of accounts to cover the revenues. These accounts will be provided for in due time. The continuance of the method of absorbing plant and equipment charges as installed by your direction July 1, 1909, has resulted in distributing plant charges to the the amount of \$27,550,635.24 to the construction divisions to June 30, 1913, leaving a balance on that date of \$1,941,488.61 to be absorbed.

The policy of requiring cash payments for material and supplies furnished and services rendered having been adopted during the year as far as appeared practicable, the work involved in collecting moneys due the commission from employees and others was considerably reduced and, what is more important, the liability of loss due to giving credit was removed.

Under the existing agreement with the Republic of Panama provision is made for the reimbursement of the United States for the expenditures incurred in connection with the construction and maintenance of waterworks, sewers, and pavements within the cities of Panama and Colon. To June 30 there has been a total expenditure on this account in the city of Panama of \$1,626,267.58 and \$1,550,030.46 in the city of Colon, a total of \$3,176,298.04, which includes accrued interest to date on the capital cost balances at the rate of 2 per cent per annum. For the work in Panama this interest has amounted to \$157,501.97 and for the work in Colon \$113,231.75. To the end of the fiscal year \$975,439.71 have been reimbursed, leaving a balance of \$2,200,858.33 still due the United States. Included in the above reimbursed amount is \$32,785.01, representing the value of water used by the Isthmian Canal Commission in the two cities.

The transfer of the duty of purchasing and issuing commissary coupon books to the Panama Railroad Co. made little difference in the work of this office, in view of the continuance of the existing method of issuing coupon books to employees of the commission and making collections therefor by deductions on pay rolls. Sixty thousand seven hundred and ninety hotel books and 1,363,100 meal tickets were issued, for which collections have been made on the pay rolls, in addition to the collection of and remittance to the Panama Railroad Co. of \$3,235,122 for commissary books issued to commission employees.

The required administrative examination of the disbursing officer's account has been made monthly and the accounts forwarded to the Auditor for the War Department in Washington.

The periodical examination of all fiscal officers' records of financial transactions and the auditing of their accounts has been continued. This involves a complete check of the records and cash and cash values in the hands of over 200 financially responsible officers, including the disbursing officer, treasurer of the Canal Zone government, cashiers of water-collecting offices and hotels, postmasters, revenue collectors, judges and clerks of courts, etc. In addition, on October 31, 1912, and on June 30, 1913, in conjunction with the local auditor of the Panama Railroad Co., checks were made of the cash in the hands of the local treasurer of that company.

The schedule bond of the Illinois Surety Co. under which 286 employees of the commission are bonded for the faithful performance of their duties involving responsibility for money or money values has been continued in force during the fiscal year and was renewed for the fiscal year ending June 30, 1914.

There has been passed to the disbursing officer for payment audited vouchers amounting to \$9,022,000 and pay rolls amounting to approximately \$20,700,000. At the close of business June 30 there were unaudited claims on hand amounting to \$57,197, the greater portion of which were in favor of the Panama Railroad Co.

The force assigned to the inspection of time books and the work of timekeepers in the field has been reduced to some extent, due in part to reduced operations at certain points and in part to a better cooperation by departments and divisions with this branch of the work. A few cases of padding time books were discovered toward the end of the year, and five or six negro timekeepers, foremen, and laborers, who were beneficiaries of the fraudulent practices, were convicted. The amounts involved were small, as the cases were discovered before the practice had continued for any material length of time.

#### CANAL ZONE GOVERNMENT ACCOUNTS.

The duties of receiving, examining, and settling all accounts pertaining to the operations of the Canal Zone government have not changed, and the financial transactions are set forth in tables herewith submitted.

The amount of revenues derived from rentals, taxation, etc., has decreased from \$259,759.68 in 1912 to \$212,266.83 in 1913. This decrease was apparently due to reduced revenues from liquor licenses in the Canal Zone and from real estate taxes and rentals. The disbursement of Canal Zone revenues increased from \$214,000 in 1912 to \$233,000 in 1913, the increase being principally due to sanitary work in native villages and increased expenditure for maintenance of Canal Zone roads and trails. In the operation of the post offices there has been an increase in the number of orders issued from 227,707 in 1912 to 238,316 in 1913, with a slight decrease in the amount involved. The value of money orders issued during the fiscal year 1912 was \$4,915,077.26, while the value of those issued in 1913 amounted to \$4,883,624.13, for which fees amounting to \$23,366.31 were collected, thus refuting the contention that has frequently been made that the installation of the postal savings system would greatly decrease the revenues derived from money orders. Money orders from all sources amounting to \$5,181,369.79 are shown in Table 26 as having been paid during the year, the increase over prior years being occasioned by the inclusion of \$1,151,144.39, covering the payments made in the United States for the months of April, May, and June, 1912, in the business of the fiscal year 1913, due to delay in receiving statements from the Auditor for the United States Post Office Department.

The revenues derived from sales of postage stamps, which in 1912 amounted to \$87,641.45, increased to \$100,917.99 during the last fiscal year. This is the largest amount ever received during any year since the establishment of the Canal Zone postal system.

Reference has been made in my preceding reports to the amount paid to the Republic of Panama under the agreement whereby the Republic receives 40 per cent of the face value of all stamps used in the Canal Zone, the stamps being furnished by the Republic of Panama. To June 30, 1913, this has amounted to \$240,930.13, and is an exceedingly heavy charge against the postal system and the revenues of the Canal Zone. While the agreement to pay the Republic of Panama a percentage on the amount of stamp sales was one of several concessions made by the United States to offset certain concessions made by the Republic of Panama, that agreement, it seems to me, was not intended to continue indefinitely, and necessarily could not have taken into consideration the amount that would be involved in continuing it in force. The application of all the postal receipts to the maintenance of the postal system would have made that system more nearly self-supporting. As it is, a very large proportion of the cost of the postal service must be met out of regular appropriations made by Congress. I renew my former recommendation for an early modification of the present agreement relieving the Canal Zone government from this charge. Authority should be obtained for the purchase of stamps direct from the United States.

The operations of the Postal Savings System has involved the issue during the year of postal savings certificates amounting to \$1,601,616, from which there have been withdrawals to the amount of \$1,312,873. The difference, together with the balance brought forward on July 1, 1913, making a total of \$645,690, represents the balance in the postal savings account at the close of business June 30, 1913. (See Table 29.)

The major portion of the funds of the Canal Zone have been continued on deposit with the two depositories at Washington, D. C., although an amount not exceeding \$100,000 is deposited in one of the banks on the Isthmus. The actual amount in all depositories on June 30, 1913, was \$2,168,339.62, secured by the deposit of high-grade bonds under control of a representative of the Government. The Secretary of War entered into new agreements with the two Washington depositories during the latter half of the fiscal year which will increase materially the amount of revenue derived by the Canal Zone government from interest. The interest received during the fiscal year 1913 amounted to \$32,647.77, an increase of \$11,862.81 over the amount received from this source during the fiscal year 1912. The total amount of interest received to the end of the fiscal year, as shown in detail in Table 23, is \$118,064.07.

The commission clubhouses received a total revenue of \$140,630.06, and expended during the year \$138,134.02, the difference, in addition to the balance brought forward on July 1, 1912, making a total of \$27,349.78 as the balance of clubhouse funds on hand at the close of business June 30, 1913. Of this amount \$25,814.56 was in the hands of the treasurer of the Canal Zone government and \$1,535.22 in the hands of the several secretaries.

#### CLAIMS FOR INJURY AND DEATH.

Under the provisions of the injury compensation act of May 30, 1908, as amended by section 5 of the act of March 4, 1911, 1,809 claims for compensation on account of injuries received in course of

employment were filed by employees during the fiscal year, and 41 claims were filed on account of deaths, a total of 1,850. The following shows the number of claims filed each year from the beginning:

	Aug. 1, 1908, to June 30, 1909.	July 1, 1909, to June 30, 1910.	July 1, 1910, to June 30, 1911.	July 1, 1911, to June 30, 1912.	July 1, 1912, to June 30, 1913.
Injuries.....	662	1,161	1,544	1,849	1,809
Deaths.....	41	38	75	50	41
Total.....	703	1,199	1,619	1,899	1,850

One thousand four hundred and fifty-two claims of employees for injuries were allowed, 130 were disallowed for the reason that the employees claiming compensation were incapacitated for less than 15 days, but in these cases payments were usually made as meritorious sick leave under the act of February 24, 1909, while 185 claims, including 25 claims pending from the previous year, were disallowed for reasons as follows:

Negligence and misconduct of the employee.....	24
Employees were not in course of employment.....	40
Claimants were not employees of the commission.....	4
Claimants were incapacitated less than 15 days.....	3
Accidents described was not the cause of incapacity.....	58
Incapacity was caused by illness.....	16
Insufficient evidence submitted to establish connection between the alleged injury and the incapacity.....	38
Failure of the employee to secure proper medical treatment.....	1

One claim under the Executive order of February 26, 1913, was disallowed, as that order was never put into effect.

Twenty-one death claims were allowed, while 8 were disallowed for the reason that in 5 of them claimants were not considered dependant parents within the meaning of the act; in 2 cases death was due to negligence or misconduct of the employee, and in 1 case the claimant was held not to be a parent within the meaning of the act.

Under the act of February 24, 1909, authorizing the chairman to grant meritorious sick leave to injured employees for not exceeding 30 days in any one year, which in its application, with certain exceptions, has been restricted to cases of incapacity lasting for 15 days or less, 4,715 cases have been allowed.

The average duration of disability of cases for which injury compensation claims have been filed is 58 days, whereas the average estimated duration of cases in which meritorious sick leave has been granted is 5 days. Payments were made during the fiscal year as follows:

On account of injury claims.....	\$150,943.79
On account of death claims.....	23,792.02
On account of grants of meritorious sick leave under the act of Feb. 24, 1909.....	49,335.91

A total for the year of. .... 224,071.72

From August 1, 1908, to June 30, 1913, the Isthmian Canal Commission has paid \$915,824.79 on account of injuries received by employees in course of employment. Further details in regard to the



particulars of injuries and deaths and the amounts paid therefor by departments and divisions of the commission will be found in Tables 16 and 17, attached hereto.

With the two exceptions noted below no detailed statistical tables have been prepared to show the causes of accidents, the classes of injuries received, the amounts paid for the various classes of injuries, or other data of a similar character. On the forms furnished by the Department of Commerce and Labor, and now by the Department of Labor, reports in each injury case are furnished that department from which valuable statistical data have been or can be compiled. The Department of Commerce and Labor has published a report on the results of the injury compensation act of May 30, 1908, which segregates all the data relating to accidents happening on the Panama Canal from the data relative to accidents reported by other departments of the United States Government. This report covers the period between August 1, 1908, and June 30, 1911. The following is quoted from page 71 of the report as being of general interest:

Under each cause the separation of the Isthmian Canal Commission and all other branches of service has been preserved, and the observation made above, that the accidents of shorter duration predominate in the Isthmian Canal Commission as compared with other branches of service, evidently holds true of each individual cause, so that it can not be explained by differences in causation. The reasons for this difference have been given above—better medical treatment in Government hospitals, better reporting of minor accidents, compensation for disability lasting 15 days or less, and also better medical supervision, which prevents undue extension of the disability period.

Using data contained in this report as a basis, I have prepared two tables, Nos. 18 and 19, giving for the 11 months ending June 30, 1909, and for the years ending June 30, 1910, and June 30, 1911, the causes of accidents resulting in injuries and the character of the injuries received by employees of the commission, adding to such tables data for the fiscal year ending June 30, 1912. On account of lack of time I was unable to complete the data for the fiscal year ending June 30, 1913.

Section 5 of the Panama Canal act approved August 24, 1912, authorized the President to prescribe a method for the determination and adjustment of all claims arising out of personal injuries to employees and to prescribe a schedule of compensation therefor. In the closing days of his administration President Taft issued an Executive order covering this matter; but as the act provided that payments could be made only out of moneys thereafter appropriated for that purpose, and as the sundry civil appropriation act failed of passage until the latter part of June, that act having contained the only authority for making payments, President Wilson suspended the operation of the order. The result has been that the provisions of the act of May 30, 1908, as amended by the act of March 4, 1911, have been continued in effect over the canal work. A new draft has been prepared and submitted to the Secretary of War modifying materially the basis for determining the amounts payable as prescribed in the order signed by President Taft. This was done so as to bring the order more in accord with the ideas that were in mind when recommendation was made for authority to provide a different schedule of compensation than that provided in the act of May 30, 1908.

## ACCOUNTING SYSTEM FOR THE PERMANENT ORGANIZATION.

Under your instructions some preliminary work was done toward gathering data for use in formulating the permanent accounting system for the Panama Canal. This work is handicapped by lack of positive knowledge as to the form the permanent organization is to take and by the fact that the present accounting organization of the commission is not established so as to insure efficient control. Centralized accounting control does not exist in the present canal organization, which makes it exceedingly difficult to satisfactorily handle some of the questions which arise. Conditions are better than they were, as this office has assumed the task of adjusting many problems and of endeavoring to get data which will be required later. The assignment to this office of the duty of supervising the preparation of the estimates for appropriations has given it the opportunity to call for data in regard to the condition of appropriations and has also made it necessary for this office to do so.

The work of formulating the accounting system must be entered upon at once if we are to be prepared when vessels first go through the canal, and I am convinced that the most satisfactory results can be obtained if the commission retains control of the work that is to be done. Compliance with the essential governmental requirements and the practical conditions on the Isthmus must be the first consideration. These can only be met in my judgment by those familiar with the two subjects. Expert assistance should be obtained, but the work should be supervised here, so that a plan consistent with conditions that actually exist and reconcilable with requirements of law and Treasury regulations, except as it is found necessary to modify them, will be worked out and submitted for approval. This will insure centralized control of the work, its prosecution on uniform lines, the using to the best advantage of information that has already been gathered or is a matter of general knowledge on the Isthmus, and the completion of the most pressing subjects first and this last is exceedingly important.

## CANAL APPROPRIATIONS AND EXPENDITURES.

Congress has appropriated a total of \$349,505,223.14 for canal construction, including the appropriations contained in the act of June 23, 1913. Of this amount \$10,676,950 was for fortifications, of which \$4,870,000 was appropriated by the act of June 23, 1913, and \$21,411.56 was for the relief of private persons. The balance, \$338,806,861.58, including \$16,265,393 appropriated by the act of June 23, 1913, was appropriated for the construction of the canal and is a charge against the total authorized bond issue of \$375,200,900 as fixed in section 39 of the tariff act of August 5, 1909. This leaves available for appropriation a balance of \$36,394,038.42. The actual cash balance on hand June 30, 1913, for the construction of the canal, excluding the amount available for fortifications, was \$20,673,904.79. The total amounts carried under appropriation items 1 and 2 for the Washington office, and items 7, 8, and 9 for the department of civil administration, were obligated. For the department of sanitation there remained unobligated in the two appropriations for salaries and wages about \$27,000 for officers and employees

and about \$29,000 for skilled and unskilled labor. In item 12 for material, supplies, and miscellaneous expenditures for that department there was practically no balance. For construction and engineering a small balance remained unobligated in item 6 covering incidental expenses. In item 3 covering salaries and wages for officers and employes, and item 4 for skilled and unskilled labor, there remained \$240,000 for item 3 and \$1,115,000 for item 4, more than enough to meet the current payments for June and prior months. It is to be noted that the skilled and unskilled labor rolls amounted to \$720,000 more during the fiscal year ending June 30, 1913, than during the preceding year, while the rolls covering the supervisory force increased about \$1,300 only. While a cash balance of \$12,879,-240.21 remained in item 5, from which miscellaneous purchases of material are made, the orders outstanding and unpaid on July 1, including orders for delivery during the present fiscal year issued before that date, amounted to about \$8,000,000. In addition there were outstanding and unpaid on June 30 chargeable against this appropriation freight charges to the Isthmus amounting to approximately \$300,000, charges for purchases on the Isthmus of \$300,000, and miscellaneous items amounting to about \$300,000, reducing the available total after adding \$5,000,000 appropriated by the act of June 23, 1913, of which \$2,000,000 was for colliers, and after crediting \$654,002.55 on account of transfer settlements made after June 30, 1913, on account of transactions prior to that date, and \$303,145.11 on account of collections to be repaid after June 30, 1913, to about \$7,950,000 to meet any additional orders, purchases, and miscellaneous expenses payable during the present fiscal year.

Five million eight hundred and fifty-six thousand eight hundred and thirty-eight dollars and thirty-five cents was collected and returned to the Treasury as miscellaneous receipts to June 30, 1913. This item represents the total amount appropriated by Congress which after being used for miscellaneous purposes in connection with the canal work has been covered back into the Treasury and lost to canal appropriations. It includes the payments made by the Panama Railroad Co. on account of loans, \$1,687,714.92; interest on loans, \$473,194.27; annual subsidy, \$631,875; and dividends, \$344,945—a total of \$3,137,729.19. For the reasons stated in my last annual report, namely, that the payment of this amount into the Treasury rendered it impossible for the railroad company to renew its roadbed and equipment and necessitated the use of moneys appropriated by Congress directly for rebuilding and reequipping the railroad, and required the commission to pay a higher price for material sold and services rendered by the railroad company, the deposit of this money in the Treasury may be considered as having reduced the total appropriations available for canal purposes.

Table 1 shows the total amount which has been made available for canal purposes as \$316,684,926.68. To this amount should be added \$506,013.02 received in reimbursement of the expenditures incurred in installing waterworks, sewers, and pavements in the cities of Panama and Colon, after adding the interest on the capital cost and deducting cost of maintenance; also the amount received from the sale of French scrap, \$80,030.33, and from the sale of unserviceable equipment or equipment no longer required, less the expenses of making such sales. This last item without excluding the cost of

making sales has amounted to \$198,991.87. For the past few years moneys received from these sources have been deposited as miscellaneous receipts and then reappropriated for canal construction purposes. Beginning with July 1, 1913, under the act of May 1, 1913, moneys received from these sources are deposited in the Treasury and are not subject to further use on the canal. The use of these amounts has increased the total actually available for canal construction purposes to the end of the fiscal year 1913 to approximately \$317,469,961.90.

Respectfully,

H. A. A. SMITH,  
*Examiner of Accounts.*

Col. GEORGE W. GOETHALS,  
*Chairman and Chief Engineer, Culebra, Canal Zone.*

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TABLE 1.—*Statement of moneys available for and applied to the purchase of canal rights and cost of canal construction to June 30, 1913.*

Appropriations by Congress (Table 3).....	\$328, 370, 026. 59	
Less:		
Appropriations for fortifications.....	\$5, 806, 950. 00	
Private acts.....	\$21, 411. 56	
Judgment, Court of Claims.....	196. 45	
	<hr/>	21, 608. 01
Collections returned to the United States Treasury as miscellaneous receipts and lost to canal appropriations (Table 4).....	5, 856, 838. 35	
	<hr/>	11, 685, 396. 36
Net amount available.....		<hr/> 316, 684, 630. 23
Classified expenditures (Table 5).....		298, 985, 812. 90
Less:		
Fortifications.....	\$3, 114, 357. 52	
Private acts.....	16, 608. 01	
	<hr/>	3, 130, 965. 53
Unapplied credits to expenditures:		
Water rentals.....	975, 439. 71	
French scrap used or sold.....	1, 161, 124. 41	
Unpaid rolls on June 30, 1913. \$2, 009, 138. 53		
Less unpaid amounts on rolls for fortifications. .	70, 319. 02	
	<hr/>	1, 938, 819. 51
Subsidies from Panama Railroad Co.....	631, 875. 00	
Dividends from Panama Railroad stock.....	344, 945. 00	
Interest on loans to Panama Railroad Co....	473, 194. 27	
Miscellaneous rentals.....	239, 061. 66	
	<hr/>	8, 895, 425. 09
Net charges to classified expenditures.....		<hr/> 290, 090, 387. 81
Material and supplies and other unclassified items (Table 2), less \$337,171.20 for fortifications.....		4, 311, 466. 84
Bills collectible outstanding.....		711, 926. 15
Due on Treasury Department transfers from fortifications.....		595, 520. 21
Unexpended appropriation balances (Table 8), except \$3,026,260.51 for fortifications and private acts.....		20, 673, 904. 79
Collections returnable to appropriations (Table 10), \$303,145.11, less \$1,720.68 due Panama Railroad Co. from collections returned to appropriations.....		<hr/> 301, 424. 43
Total accounted for.....		<hr/> 316, 684, 630. 23

TABLE 2.—*Statement of receipts, disbursements, and balances available June 30, 1913.*

## RECEIPTS.

Appropriations by Congress (Table 3).....	\$328, 370, 026. 59
Water rentals (Panama and Colon).....	975, 439. 71
Salvage from French material and equipment.....	1, 161, 124. 41
Collections account sale of Government property, etc. (Table 4)....	5, 856, 838. 35
Collections due individuals and companies.....	6, 893. 10
Total receipts.....	<hr/> 336, 370, 322. 16

TABLE 2.—*Statement of receipts, disbursements, and balances available June 30, 1913—*  
Continued.

DISBURSEMENTS.	
Classified expenditures (Table 5).....	\$298, 985, 812. 90
Department of civil administration.....	\$6, 393, 308. 73
Department of law.....	44, 982. 27
Department of sanitation.....	16, 250, 164. 93
Hospitals and asylums.....	\$8, 438, 940. 76
Sanitation.....	6, 683, 462. 68
Construction and repair of buildings.....	1, 127, 761. 49
Department of construction and engineering... 185, 316, 095. 75	
Atlantic division.....	\$53, 504, 462. 14
Central division.....	83, 942, 519. 45
Pacific division.....	47, 355, 130. 53
General.....	513, 983. 63
General items.....	87, 866, 903. 70
Fortifications.....	3, 114, 357. 52
Paid into the United States Treasury for sales of Government prop- erty, etc.....	5, 856, 838. 35
Services rendered and material sold individuals and companies.....	4, 167, 762. 42
Unclassified expenditures.....	4, 648, 638. 04
Material and supplies.....	\$3, 769, 924. 90
Other unclassified items, including suspense accounts for Ancon-Sosa and Balboa fills, \$180,550.52; armament of fortifications, \$335,- 756. 20; June overhead expenses, \$224,221.26; and other expenses awaiting distribution by divisions.....	878, 713. 14
Bills collectible outstanding.....	711, 926. 15
Total disbursements.....	314, 370, 977. 86
Less amounts included above, but unpaid on June 30, 1913.....	2, 009, 138. 53
Salaries and wages unpaid on rolls to June 1, 1913.....	\$240, 380. 25
Pay rolls for the month of June, 1913.....	1, 768, 758. 28
Net disbursements.....	312, 361, 839. 33
Cash balances, June 30, 1913.....	24, 008, 482. 83
Congressional appropriations (Table 8).....	23, 700, 165. 30
June, 1913, collections returnable to appropri- ations (Table 10).....	303, 145. 11
Collections, account individuals and companies.....	5, 172. 42
Due individuals and companies.....	\$6, 893. 10
Less amounts due Panama Rail- road from collections repaid appropriations.....	1, 720. 68
Total accounted for.....	336, 370, 322. 16

TABLE 3.—Statement of appropriations by Congress.

	Total.	Act of June 30, 1906 (f. y. 1907).	Acts of Mar. 4, 1907, and Feb. 15, 1908 (f. y. 1908).	Acts of May 27, 1908, and Mar. 4, 1909 (f. y. 1909).	Acts of Mar. 4, 1909, and Feb. 25, 1910 (f. y. 1910).	Act of June 25, 1910 (f. y. 1911).	Act of Mar. 4, 1911 (f. y. 1912).	Act of Aug. 24, 1912 (f. y. 1913).
Canal rights from French company (act of June 28, 1902).....	\$40,000,000.00							
Canal Zone rights from Republic of Panama (act of Apr. 28, 1904).....	10,000,000.00							
Canal connecting Atlantic and Pacific Oceans: Act of June 28, 1902.....	10,000,000.00							
Act of Dec. 21, 1905.....	11,000,000.00							
Deficiency for fiscal year 1906 (act of Feb. 27, 1906):								
Miscellaneous material purchases in the United States.....	1,000,000.00							
Miscellaneous material purchases on the Isthmus.....	400,000.00							
Payments to Panama R. R. Co.....	200,000.00							
Isthmus pay rolls.....	2,100,000.00							
Salaries and services in the United States.....	1,750,000.00							
New-equipment purchases.....	1,565,786.00							
Reequipment of Panama R. R.....	650,000.00							
Total for purchase of rights and for lump-sum appropriations common to all departments.....	76,990,786.00							
Expenses in the United States:								
Salaries.....	1,172,683.33	\$251,063.33	\$202,600.00	\$149,000.00	\$150,000.00	\$140,000.00	\$130,000.00	\$150,000.00
Incidental expenses.....	458,179.36	117,179.36	69,000.00	27,000.00	75,000.00	70,000.00	50,000.00	50,000.00
Construction and engineering:								
Pay of officers and employees.....	24,304,212.00	2,650,512.00	2,982,700.00	4,000,000.00	3,871,000.00	3,900,000.00	3,900,000.00	3,000,000.00
Pay of skilled and unskilled laborers.....	86,434,961.00	9,050,661.00	13,526,300.00	10,858,000.00	12,000,000.00	13,500,000.00	16,500,000.00	11,000,000.00
Miscellaneous material purchases, etc.....	95,881,514.24	9,032,814.24	15,131,700.00	15,200,000.00	10,517,000.00	15,000,000.00	19,000,000.00	12,000,000.00
Incidental expenses on Isthmus.....	5,190,250.00	94,550.00	715,700.00	400,000.00	1,003,000.00	900,000.00	950,000.00	790,000.00
Civil administration:								
Pay of officers and employees.....	3,507,000.00	600,000.00	486,000.00	225,000.00	546,000.00	600,000.00	550,000.00	500,000.00
Pay of skilled and unskilled laborers.....	191,000.00	50,000.00	50,000.00	16,000.00	20,000.00	20,000.00	20,000.00	15,000.00
Material and expenses.....	1,032,200.00	318,200.00	289,000.00		140,000.00	100,000.00	110,000.00	75,000.00
Sanitary department:								
Pay of officers and employees.....	4,641,000.00	550,000.00	766,000.00	700,000.00	725,000.00	600,000.00	600,000.00	700,000.00
Pay of skilled and unskilled laborers.....	2,766,968.00	579,068.00	637,900.00	500,000.00	450,000.00	200,000.00	200,000.00	200,000.00
Material and expenses.....	4,787,367.15	\$22,367.15	800,000.00	375,000.00	740,000.00	750,000.00	800,000.00	500,000.00
Reequipment of Panama R. R.....	1,185,000.00	1,000,000.00	1,385,000.00	1,100,000.00	700,000.00			
Relocation of Panama R. R.....	7,815,000.00			1,085,000.00	1,980,000.00	2,000,000.00	2,750,000.00	

TABLE 3.—Statement of appropriations by Congress—Continued.

	Total.	Act of June 30, 1906 (f. y. 1907).	Acts of Mar. 4, 1907, and Feb. 15, 1908 (f. y. 1908).	Acts of May 27, 1908, and Mar. 4, 1909 (f. y. 1909).	Acts of Mar. 4, 1909, and Feb. 25, 1910 (f. y. 1910).	Act of June 25, 1910 (f. y. 1911).	Act of Mar. 4, 1911 (f. y. 1912).	Act of Aug. 24, 1912 (f. y. 1913).
Redemption of first-mortgage bonds of Panama R. R. Co.	\$2, 298, 367.50		\$2, 298, 367.50					
Sanitation in the cities of Panama and Colon.	800, 000.00				\$800, 000.00			
Survey of lands, Canal Zone.	75, 000.00					\$5, 000.00		
Relief of Bentrock B. Banton for injuries.	10, 000.00			\$10, 000.00				
Total regular fiscal year appropriations.	227, 837, 782.58	\$25, 456, 415.08	27, 161, 367.50	29, 187, 000.00	33, 638, 000.00	37, 855, 000.00	\$45, 550, 000.00	\$28, 980, 000.00
Total deficiency appropriations.	17, 712, 990.00		12, 178, 900.00	5, 458, 000.00	70, 000.00			
Total lump-sum appropriations.	76, 990, 785.00							
Total for canal construction to June 30, 1913.	\$22, 541, 468.58							
Fortifications:								
Armament of fortifications.	1, 500, 000.00						1, 000, 000.00	500, 000.00
Seacoast batteries.	3, 000, 000.00						2, 000, 000.00	1, 000, 000.00
Surveys.	50, 000.00							50, 000.00
Causeways.	150, 000.00							150, 000.00
Submarine mine structures.	220, 200.00							220, 200.00
Field fortifications and camps.	200, 000.00							200, 000.00
Manufacture and test of ammunition.	575, 000.00							575, 000.00
Submarine mines.	111, 750.00							111, 750.00
Private acts for relief of—								
Elizabeth G. Martin, June 17, 1910.	1, 200.00				1, 200.00			
Marcellus Truxell, Jan. 13, 1911.	1, 500.00					1, 500.00		
W. L. Miles, Feb. 13, 1911.	1, 704.18					1, 704.18		
Chas. A. Caswell, March 2, 1911.	1, 055.00					1, 055.00		
Heirs of Robert S. Gill, July 3, 1912.	2, 520.00							2, 520.00
Douglas B. Thompson, July 3, 1912.	1, 500.00							1, 500.00
Allesandra Comba, July 10, 1912.	500.00							500.00
Peter Wigginton, Feb. 7, 1913.	500.00							500.00
Raymond R. Ridenour, Feb. 7, 1913.	500.00							500.00
Heirs of Charles E. Stump, Feb. 7, 1913.	1, 500.00							1, 500.00
Parents of Edward Maher, Feb. 18, 1913.	1, 980.00							1, 980.00
Oscar F. Lackey, Feb. 18, 1913.	1, 500.00							1, 500.00
Pedro Sanchez, Feb. 18, 1913.	2, 000.00							2, 000.00
John H. Cole, Feb. 18, 1913.	1, 951.38							1, 951.38
Robert Coggan, Feb. 18, 1913.	1, 500.00							1, 500.00
Total appropriations by Congress to June 30, 1913.	228, 369, 830.14							



NOTE.—The appropriations made primarily for fiscal years were made available until expended, and for 1912 and 1913 were made immediately available.

1 By an act approved June 23, 1913, the following appropriations were made available for canal purposes for the fiscal year 1914:

In the United States:	
Salaries.....	\$153,393.00
Incidental expenses.....	63,000.00
Construction and engineering:	
Pay of officers and employees.....	2,725,000.00
Pay of skilled and unskilled laborers.....	6,125,000.00
Miscellaneous material purchases, etc.....	5,000,000.00
Incidental expenses on Isthmus.....	725,000.00
Civil administration:	
Pay of officers and employees.....	500,000.00
Material and expenses.....	74,000.00
Sanitary department:	
Pay of officers and employees.....	450,000.00
Pay of skilled and unskilled laborers.....	150,000.00
Material and expenses.....	300,000.00
Total for canal work, fiscal year 1914.....	16,265,393.00

NOTE.—Total of appropriations by Congress to June 30, 1913, does not include judgment by the Court of Claims, No. 29917, dated Dec. 4, 1911, favor Timothy J. Butler for leave of absence denied by Isthmian Canal Commission and paid by settlement No. 1004, dated Oct. 2, 1912, from deficiency act approved Aug. 26, 1912, amount \$196.43.

#### Fortifications:

Surveys for military purposes.....	\$12,000.00
Land for military purposes.....	50,000.00
Seacoast batteries.....	2,365,000.00
Electric light and power plants, seacoast fortifications.....	173,000.00
Searchlights for seacoast fortifications.....	285,000.00
Sanitary clearing, filling, etc.....	210,000.00
Armament of fortifications.....	1,575,000.00
Fire control at fortifications.....	200,000.00
Total for fortifications, fiscal year 1914.....	4,870,000.00

TABLE 4.—*Detailed statement of collections which have been deposited in the United States Treasury as miscellaneous receipts and lost to canal appropriations to June 30, 1913.*

Sales of Isthmian Canal property.....		\$1,085,463.03
Sale of property.....	\$850,500.11	
Sale of French material and equipment.....	81,634.80	
Sale of water.....	255.43	
Sale of Panama R. R. stock.....	1,300.00	
Mess accounts.....	46,879.48	
Receipts from pay patients.....	79,992.68	
Quarantine subsistence.....	24,900.53	
Rentals of Isthmian Canal property.....		521,441.02
Rent of lands and buildings.....	41,427.24	
Rent of equipment.....	311,047.33	
Panama water and sewer rentals.....	71,967.71	
Colon water and sewer rentals.....	31,573.00	
Rentals, miscellaneous.....	65,425.74	
Work done by Isthmian Canal Commission.....		207,786.52
Labor furnished Panama R. R. Co.....	180,336.97	
Other labor furnished.....	27,449.55	
Miscellaneous.....		3,065,327.78
Telegraph and telephone service.....	3,547.35	
Hotels and boarding camps.....	758,470.34	
Hotel coupon books.....	32,238.28	
Laundry receipts.....	7,382.01	
Corral receipts.....	8,628.56	
Miscellaneous.....	93,740.47	
Interest on loans.....	473,194.27	
Repayment of loans.....	1,687,714.92	
Pay-car overages.....	411.58	
Subsidies and dividends.....		976,820.00
Annual subsidy from Panama R. R. Co.....	631,875.00	
Dividends on Panama R. R. stock.....	344,945.00	
Total.....		5,856,838.35

TABLE 5.—*Detailed statement of classified expenditures for the fiscal year ending June 30, 1913, and total from the beginning of the work to date.*

	Total fiscal year 1913.	Total to June 30, 1913.
Department of civil administration:		
Administration.....	\$54,491.57	\$605,828.09
Supreme and circuit courts.....	32,723.71	364,669.72
Prosecuting attorney.....		39,558.47
Division of revenues.....	18,444.62	184,559.75
Division of posts.....	79,651.14	732,609.56
Division of customs.....	9,094.67	75,825.34
Division of lands and buildings.....		102,046.07
Division of estates.....	3,225.02	29,897.65
Police and prisons.....	273,495.12	2,262,693.02
Fire protection.....	104,260.57	795,753.33
Maintenance and operation of waterworks and sewers—Panama.....	23,997.74	168,748.90
Colon.....	43,359.82	252,935.40
Repairs and maintenance of pavements—Panama.....	14,472.96	41,240.52
Colon.....	7,801.78	46,958.57
Miscellaneous Zone public works.....	4,822.84	33,442.96
Treasurer of the Canal Zone.....	8,860.82	47,264.80
Construction of buildings.....	407.91	514,519.41
Repairs of buildings.....	2,278.77	19,757.17
Survey of Canal Zone lands.....		75,000.00
Total, department of civil administration.....	681,389.06	6,393,308.73
Department of law:		
Office of counsel and chief attorney.....	18,718.68	36,651.11
Land office.....	1,534.43	8,331.16
Total, department of law.....	20,253.11	44,982.27

TABLE 5.—Detailed statement of classified expenditures for the fiscal year ending June 30, 1913, and total from the beginning of the work to date—Continued.

	Total fiscal year 1913.	Total to June 30, 1913.
Department of sanitation:		
Administration.....	\$69,782.58	\$846,233.85
Hospitals and asylums—		
Medical storehouse, Colon.....	9,534.65	41,098.79
Ancon hospital.....	388,848.05	3,680,469.46
Colon hospital.....	187,439.24	1,905,673.64
Taboga sanitarium.....	24,990.36	125,347.24
Santo Tomas hospital.....	9,877.50	60,499.66
Other hospitals, dispensaries, and sick camps.....	171,050.46	2,076,229.21
Quarantine.....	41,454.68	360,420.95
Sanitation, Panama and Colon—		
Sanitation proper, Panama.....	36,810.55	806,065.78
Disposal of garbage, street cleaning, etc., Panama.....	8,255.25	78,629.30
Sanitation proper, Colon.....	26,144.51	609,035.51
Disposal of garbage, street cleaning, etc., Colon.....	2,372.35	38,992.28
Zone sanitation—		
Sanitation proper.....	371,844.90	4,016,067.29
Disposal of garbage, street cleaning, etc.....	65,101.61	486,173.62
Construction of buildings.....	<sup>1</sup> 62.21	1,033,799.25
Repairs of buildings.....	16,489.62	93,962.24
Corozal farm.....	5,466.86	5,466.86
Total, department of sanitation.....	1,435,400.96	16,250,164.93
Department of construction and engineering:		
Atlantic division—		
Dry excavation (prism), construction work.....	13,910.16	1,480,371.43
Dredging excavation (prism)—		
Construction work.....	1,465,328.01	8,422,057.42
Plant.....	<sup>1</sup> 292,748.95	93,373.02
Gatun dam and spillway—		
Construction work.....	1,260,458.03	11,868,366.05
Plant.....	<sup>1</sup> 179,906.73	<sup>1</sup> 295,447.57
Gatun locks—		
Construction work.....	6,345,032.50	28,143,938.81
Plant.....	22,380.60	198,251.22
Gatun power plant, permanent—		
Construction work.....	326,487.83	364,102.85
Plant.....	2,195.54	2,195.54
Rock and sand account—		
Porto Bello rock plant.....	<sup>1</sup> 3,081.21	185,627.32
Transportation plant.....	<sup>1</sup> 116,193.17	305,866.29
Colon breakwater—		
Construction work.....	972,210.51	2,636,178.85
Plant.....	<sup>1</sup> 204,429.10	6,941.03
Gatun-Mindi levee.....		72,468.47
Terminal facilities, Cristobal, construction work.....	14,488.14	14,488.14
Clearing drift in Gatun Lake.....	5,683.27	5,683.27
Total, Atlantic division.....	9,631,815.43	53,504,462.14
Central division—		
Dry excavation—		
Construction work.....	7,489,132.30	83,802,494.10
Plant.....	<sup>1</sup> 121,032.55	<sup>1</sup> 53,095.71
Dredging excavation—		
Construction work.....	10,694.93	20,493.33
Plant.....	9,243.74	9,243.74
Clearing channel in Gatun Lake.....	7,924.47	149,351.22
Masonry—		
Construction work.....		12,432.77
Plant.....	<sup>1</sup> 17,516.00	1,600.00
Total, central division.....	7,378,446.89	83,942,519.45
Pacific division—		
Dry excavation (prism)—		
Construction work.....	2,275,189.75	3,325,393.01
Plant.....	<sup>1</sup> 185,304.20	62,619.43
Dredging excavation (prism)—		
Construction work.....	1,995,513.58	10,504,742.18
Plant.....	<sup>1</sup> 753.13	744,525.02
Pedro Miguel locks and dams—		
Construction work.....	3,138,274.06	11,641,750.34
Plant.....	<sup>1</sup> 76,614.34	22,995.12
Miraflores locks and dams—		
Construction work.....	7,089,098.55	18,160,580.21
Plant.....	<sup>1</sup> 353,252.53	75,068.96

<sup>1</sup> Credit.

TABLE 5.—*Detailed statement of classified expenditures for the fiscal year ending June 30, 1913, and total from the beginning of the work to date—Continued.*

	Total fiscal year 1913.	Total to June 30, 1913.
Department of construction and engineering—Continued.		
Pacific Division—Continued.		
Rock and sand account—		
Ancon rock plant.....	<sup>1</sup> \$105,601.21	\$109,046.68
Chame sand plant.....	<sup>1</sup> 155,668.91	3,753.24
Miraflores power plant, construction work.....	<sup>1</sup> 87,878.80	174,485.60
Naos Island breakwater, construction work.....	212,155.41	405,100.88
Terminal facilities, Balboa—		
Construction work.....	1,691,282.49	1,864,169.12
Plant.....	207,394.86	260,900.74
Total, Pacific division.....	15,643,835.58	47,355,130.53
General—		
Lighting and buoying the canal—		
Construction work.....	244,490.27	370,485.08
Plant.....	2,649.12	26,882.85
Permanent buildings—		
Construction work.....	63,889.29	63,889.29
Plant.....	5,273.19	5,273.19
Electric transmission line—		
Construction work.....	14,015.63	14,015.63
Plant.....	1,382.90	1,382.90
Permanent oil pipe line, construction.....	32,054.69	32,054.69
Total, general.....	363,755.09	513,983.63
General items:		
Hotels, messes, and kitchens, operations.....	<sup>1</sup> 29,277.08	<sup>1</sup> 99,622.25
Hotel equipment.....	27,741.55	46,789.05
Hotels, incidental expenses.....	20,642.87	39,806.97
Hotel Tivoli.....	<sup>1</sup> 76,256.55	<sup>1</sup> 156,333.96
Hotels, messes, and kitchens, alterations and improvements.....	38,845.77	114,355.98
Lands purchased—		
For construction work or to be flooded.....	111,143.57	441,387.30
For other purposes.....	26,380.50	153,418.85
Joint land commission.....	22,456.00	22,456.00
Cristobal terminals—		
Docks and wharves.....	<sup>1</sup> 23,810.73	238,671.60
Dredging.....		84,773.74
Balboa terminals, docks and wharves.....	<sup>1</sup> 5,765.31	167,102.82
Panama R. R. second main track.....		1,123,477.93
Relocation of Panama R. R.—		
Construction work.....	126,327.29	8,656,061.20
Maintenance.....	73,124.94	117,537.00
Plant.....	<sup>1</sup> 98,220.99	211,106.28
Purchase, improvement, and repair of steamers—		
Panama.....		655,942.48
Colon.....		579,812.22
Cristobal.....		716,085.43
Ancon.....		728,271.88
Construction of buildings, department of construction and engineering.....	27,985.02	9,619,984.96
Alteration and repair of buildings, department of construction and engineering.....	127,071.71	668,261.41
Purchase from New Panama Canal Co.....		40,000,000.00
Payment to Republic of Panama.....		10,000,000.00
Loans to Panama R. R. Co.....		3,247,332.11
Purchase of Panama R. R. stock.....		157,118.24
Construction of waterworks and sewers—		
Panama.....	<sup>1</sup> 159.87	681,057.91
Colon.....	<sup>1</sup> 1,920.28	612,313.36
Zone waterworks and sewers—		
Construction—		
Zone proper.....	25,999.96	3,301,108.74
Panama system.....	1,153.43	490,073.45
Colon system.....	230,742.12	520,064.88
Ancon filtration plant.....		19,816.33
Permanent supply.....	12,641.75	12,641.75
Maintenance.....	287,667.14	1,241,507.26
Paving Panama.....	<sup>1</sup> 1,655.90	577,718.28
Paving Colon.....	89,991.35	524,591.38
Zone roadways—		
Construction work.....	1,599.01	1,413,103.58
Repairs and maintenance.....	64,609.66	207,376.46
Miscellaneous grading and other municipal work.....		4,142.62
Moving and care of French material and equipment.....		2,833.23
Plant in Panama R. R. service.....	<sup>1</sup> 19,543.01	687,519.47
Permanent plant.....	3,808.00	37,297.76
Total, general items.....	1,063,322.52	87,866,903.70

<sup>1</sup> Credit.

TABLE 5.—*Detailed statement of classified expenditures for the fiscal year ending June 30, 1913, and total from the beginning of the work to date—Continued.*

	Total fiscal year 1913.	Total to June 30, 1913.
Fortifications:		
Atlantic—		
Seacoast batteries, emplacement.....	\$757,400.86	\$999,455.14
Submarine mines structures.....	6,682.74	6,682.74
Plant.....	<sup>1</sup> 45,509.85	7,328.44
Total, Atlantic fortifications.....	718,573.75	1,013,466.32
Pacific—		
Seacoast batteries, emplacement.....	736,865.59	1,041,613.01
Submarine mines structures.....	3,971.88	3,971.88
Causeway.....	44,563.78	44,563.78
Plant.....	<sup>1</sup> 15,989.59	39,505.37
Total, Pacific fortifications.....	799,411.66	1,129,654.04
Land defenses and barracks—		
Surveys.....	28,691.43	28,691.43
Field fortifications and camps.....	13,099.52	13,099.52
Total, land defenses and barracks.....	41,790.95	41,790.95
Guns and ammunition, armaments to fortifications.....	371,699.50	929,446.21
Total, fortifications.....	1,901,475.86	3,114,357.52
Grand total.....	38,119,694.50	298,985,812.90

<sup>1</sup> Credit.

*Expenditure accounts which are prorated monthly to the construction divisions and departments of sanitation and civil administration as overhead charges, for the fiscal year ending June 30, 1913.*

General administrative expenses.....	\$249,471.68
Miscellaneous general expenses:	
On the Isthmus.....	111,134.25
Canal Record.....	21,524.39
Isthmian Canal Commission clubhouses, operation.....	49,925.96
Isthmian Canal Commission band.....	8,765.99
In the United States.....	90,826.71
Disbursing officers:	
In Washington.....	36,848.56
On the Isthmus.....	75,578.18
Examiner of accounts:	
In Washington.....	12,914.74
On the Isthmus.....	194,881.64
Transportation on the Isthmus:	
Passenger.....	109,938.72
Freight.....	492,000.00
Telegraph and telephones.....	106,907.17
Purchasing expenses in the United States.....	167,405.86
Inspection expenses in the United States:	
Lock gates.....	29,693.85
Operating machinery.....	76,216.18
Emergency dams.....	31,927.79
Spillway gates and machinery.....	2,633.49
Balboa shops buildings.....	7,286.76
Electric transmission line.....	1,516.86
Administration building and permanent quarters.....	7.98
Dry docks.....	231.88
Compensation to injured employees.....	186,660.34
Operation of stores.....	503,358.21
Recruiting.....	77,777.49
Quarters.....	448,603.69
Construction of buildings, department of construction and engineering.....	3,887.93
Alteration and repair of buildings, department of construction and engineering.....	11,086.69
Operation of docks and wharves:	
By the Panama Railroad.....	46,166.51
By the Isthmian Canal Commission.....	15,278.55
Total.....	3,170,458.05





TABLE 7.—Statement of plant and equipment purchased for and absorbed in construction work to June 30, 1913.

	Debits.			Credit by arbitraries charged to work.		Balance to be absorbed after June 30, 1913.
	Plant charge to June 30, 1912.	Fiscal year 1913.	Total plant charges.	Arbitraries applied to June 30, 1912.	Fiscal year 1913.	Total arbitraries applied.
ATLANTIC DIVISION PLANT.						
Dry excavation.....	\$267,790.49	.....	\$267,790.49	\$267,790.49	.....	\$267,790.49
Dredging excavation.....	2,133,787.87	\$42,559.52	2,176,347.39	1,717,665.90	\$335,308.47	2,082,974.37
Gatun Dam and Spillway.....	1,555,935.44	1,100,765.90	1,395,169.54	1,671,476.28	19,140.83	1,690,617.11
Gatun Locks.....	2,475,127.36	87,499.88	2,562,627.24	2,395,812.54	201,362.21	2,600,174.75
Hydroelectric plant.....	.....	25.99	25.99	.....	.....	25.99
Porto Bello rock.....	1,204,988.52	55,774.60	1,260,763.12	1,016,279.99	58,555.81	1,075,135.80
Nombre de Dios sand.....	433,883.39	.....	1,433,583.39	443,583.39	.....	1,443,583.39
Transportation.....	1,882,144.81	115,702.73	1,896,411.78	1,400,085.05	100,490.44	1,500,575.49
Colon Breakwater.....	405,026.83	1,192,234.69	212,792.14	138,636.70	12,194.41	205,831.11
Total.....	10,368,384.41	1,182,843.33	10,185,541.08	9,196,350.34	730,352.17	9,926,702.51
CENTRAL DIVISION PLANT.						
Dry excavation.....	10,239,903.50	1,95,883.47	10,144,020.03	10,171,966.66	25,149.08	10,197,115.74
Dredging excavation.....	.....	9,243.74	9,243.74	.....	.....	.....
Masonry.....	19,116.00	117,516.00	1,600.00	.....	.....	.....
Total.....	10,259,019.50	1,104,155.73	10,154,883.77	10,171,966.66	25,149.08	10,197,115.74
PACIFIC DIVISION PLANT.						
Dry excavation.....	442,785.56	78,890.03	521,675.59	194,861.93	264,194.23	459,056.16
Dredging excavation.....	3,421,038.51	396,299.74	3,817,938.25	2,676,360.36	397,052.87	3,073,413.23
Pedro Miguel Locks and Dams.....	913,284.91	134,101.01	879,183.90	828,077.06	70,537.88	898,614.94
Miraflores Locks and Dams.....	1,409,338.99	31,577.44	1,440,916.43	1,009,509.57	430,311.02	1,439,820.59
Ancon rock.....	844,942.11	42,876.15	887,818.26	630,294.22	148,477.36	778,771.58
Chame sand.....	412,098.20	1,115,982.00	326,146.20	282,676.05	39,716.91	322,392.96
Miraflores power plant.....	499,047.95	9,934.95	508,982.90	236,683.55	97,813.75	174,485.60
Terminal facilities—Balboa.....	53,505.88	327,645.09	381,150.97	.....	120,250.23	130,250.23
Total.....	8,026,642.11	737,170.39	8,763,812.50	5,858,462.74	1,568,354.25	7,426,816.99
CHAIRMAN'S OFFICE PLANT.						
Hydroelectric plant.....	.....	2,169.55	2,169.55	.....	.....	2,169.55
Operating-machinery installation:	.....	.....	.....	.....	.....	.....
Gatun.....	96,555.80	139,242.93	235,798.73	.....	.....	235,798.73
Pedro Miguel.....	14,401.61	28,024.55	42,426.16	.....	.....	42,426.16
Miraflores.....	28,492.07	45,481.05	73,973.12	.....	.....	73,973.12



Lighting and buoying the canal.....	24, 233. 73	2, 649. 12	26, 882. 85	.....	.....	.....	26, 882. 85
Permanent buildings.....		5, 273. 19	5, 273. 19	.....	.....	.....	5, 273. 19
Construction electric-transmission line.....		1, 382. 90	1, 382. 90	.....	.....	.....	1, 382. 90
Total.....	163, 083. 21	224, 223. 29	387, 906. 50	.....	.....	.....	387, 906. 50
Grand total.....	28, 817, 729. 23	674, 394. 62	29, 492, 123. 85	25, 226, 779. 74	2, 323, 855. 50	27, 550, 635. 24	1, 941, 488. 61
SEACOAST BATTERIES PLANT.							
Atlantic.....	52, 838. 29	2, 716. 69	55, 554. 98	.....	48, 226. 54	48, 226. 54	7, 328. 44
Pacific.....	55, 494. 90	24, 181. 24	79, 676. 20	.....	40, 170. 83	40, 170. 83	39, 505. 37
MISCELLANEOUS PLANT NOT CREDITED BY ARBITRARIES.							
Relocation of Panama R. R.....	309, 327. 27	1 98, 220. 99	211, 106. 28	.....	.....	.....	.....
Plant loaned to Panama R. R.....	707, 062. 48	1 19, 543. 01	687, 519. 47	.....	.....	.....	.....
Purchase, improvement, and repair of steamers:							
Panama (less rentals).....	655, 942. 48	.....	655, 942. 48	.....	.....	.....	.....
Colon (less rentals).....	579, 812. 22	.....	579, 812. 22	.....	.....	.....	.....
Cristobal.....	716, 058. 43	.....	716, 058. 43	.....	.....	.....	.....
Ancon.....	728, 271. 88	.....	728, 271. 88	.....	.....	.....	.....
Permanent shops.....	33, 489. 76	3, 808. 00	37, 297. 76	.....	.....	.....	.....
Total.....			33, 243, 363. 55	.....	.....	.....	.....

<sup>1</sup> Credit by transfers.

<sup>2</sup> Arbitraries applied in excess of plant charges to be adjusted.

NOTE.—This statement does not include docks and wharves, construction of buildings, waterworks and sewers, pavements and roads.

TABLE 8.—Statement of receipts and disbursements from appropriations for fiscal year ending June 30, 1913.

	Balance brought forward July 1, 1912.	Act of Aug. 24, 1912.	Collections repaid appropriations during fiscal year.	Transfers between Isthmian Canal Commission appropriations on charges rendered between departments.	Total available during the year.	Disbursements.	Cash balances June 30, 1913.
In the United States:							
Salaries.....	\$12,695.52	\$150,000.00	\$2,318.46	.....	\$165,013.98	\$152,055.36	\$12,958.62
Incidentals.....	18,603.32	50,000.00	1,335.31	.....	69,938.63	64,935.32	5,003.31
Construction and engineers:							
Officers and employees.....	1,118,049.46	3,000,000.00	82,298.31	\$43,127.44	4,243,475.21	3,663,031.36	579,843.85
Skilled and unskilled labor.....	5,089,803.75	11,000,000.00	151,487.38	209,334.53	17,050,625.66	14,686,191.33	2,364,434.33
Material and supplies.....	14,622,816.94	12,000,000.00	5,101,420.72	408,159.66	32,192,397.32	19,313,156.91	12,879,240.41
Incidental expenses.....	87,359.64	790,000.00	30,454.53	11,869.24	919,683.41	827,019.17	92,664.24
Civil administration:							
Officers and employees.....	92,506.16	500,000.00	35,040.67	3,700.00	631,246.83	575,012.90	56,233.93
Skilled and unskilled labor.....	7,497.38	15,000.00	.....	47.12	22,544.50	22,394.77	149.73
Material and expenses.....	60,369.60	75,000.00	311.64	136,596.51	99,084.79	34,980.66	64,104.13
Sanitation:							
Officers and employees.....	15,717.81	700,000.00	58,335.77	494.95	774,548.53	689,073.90	85,474.63
Skilled and unskilled labor.....	35,517.77	200,000.00	13,539.52	137.21	249,194.50	199,728.58	49,465.92
Material and expenses.....	206,486.70	500,000.00	71,877.33	1182,319.80	656,044.23	342,106.84	313,877.39
Canal connecting Atlantic and Pacific Oceans.....	1,488,629.41	.....	.....	.....	1,488,629.41	25,041.21	1,463,588.20
Reequipment of Panama R. R.....	2,048,170.47	.....	147,009.35	1,116,480.27	2,048,170.47	.....	2,048,170.47
Relocation of Panama R. R.....	890,384.74	.....	.....	1103,066.98	920,913.82	359,083.83	561,228.99
Sanitation in cities of Panama and Colon.....	200,532.62	.....	.....	1478.41	97,465.64	.....	97,465.64
Survey of lands, Canal Zone.....	478.41	.....	.....	.....	.....	.....	.....
Total.....	26,655,619.76	28,980,000.00	5,695,428.99	297,928.18	61,628,976.93	40,955,072.14	20,673,904.79
Armament of fortifications.....	498,945.73	1,075,000.00	.....	.....	1,573,945.73	764,148.14	809,797.59
Seacoast batteries.....	1,534,466.38	1,000,000.00	.....	1,295,346.46	2,239,103.92	755,594.28	1,483,509.64
Surveys for military purposes.....	.....	50,000.00	.....	.....	50,000.00	.....	50,000.00
Causeway or bridge connecting fortifications.....	.....	150,000.00	.....	12,881.72	147,418.28	.....	147,418.28
Submarine mine structures.....	.....	220,200.00	.....	.....	220,200.00	.....	220,200.00
Field fortifications and camps.....	.....	200,000.00	.....	.....	200,000.00	.....	200,000.00
Submarine mines.....	.....	111,750.00	.....	.....	111,750.00	1,415.00	110,335.00
Total.....	2,033,396.11	2,806,950.00	.....	1,297,928.18	4,542,417.93	1,521,157.42	3,021,260.51
Private acts.....	.....	15,951.38	.....	.....	15,951.38	10,951.38	5,000.00
Judgment Court of Claims.....	.....	196.45	.....	.....	196.45	196.45	.....
Total.....	.....	16,147.83	.....	.....	16,147.83	11,147.83	5,000.00
Grand total.....	28,689,015.87	31,803,997.83	5,695,428.99	.....	66,187,542.69	42,487,377.39	23,700,165.30

1 Charges against appropriation. Items not marked (1) are credits to appropriations and offset total charges in this column.

TABLE 9.—Detailed statement of amounts returnable to appropriations collected during the fiscal year ending June 30, 1913.

Nature of collections.	From employees (act of Mar. 4, 1907).	From outside parties <sup>1</sup> (act of Aug. 24, 1912).	From other departments of the Government.	From over-payments and miscellaneous items.	Total.
Sale of property.....	\$18,884.78	\$2,409,900.26	\$31,643.05	\$12,940.21	\$2,473,368.30
Panama water rents.....		125,001.66			125,001.66
Colon water rents.....		88,457.79			88,457.79
Zone water rents.....			5,743.31		5,743.31
Rentals, miscellaneous.....		41,864.83			41,864.83
Labor furnished Panama R. R. Co.....		647,681.96			647,681.96
Other labor furnished.....	2,436.46	141,678.74	49,025.70		193,140.90
Sale of hotel books.....	5,152.48	301,118.20			306,270.68
Hotel and boarding-camp receipts.....	1,165,804.96	62,856.72			1,228,661.68
Hospital receipts.....	127,068.09	78,603.02	1,169.34		206,840.45
Laundry receipts.....	10,791.53	6,057.30	39.48		16,888.31
Quarantine receipts.....	523.53	20,950.12			21,473.65
Corral receipts.....	14,101.55	58,862.47	8,130.98		81,095.00
Telegraph and telephone receipts.....	935.28	651.96	25.45		1,612.69
Transportation.....	186.23	362.92	40.00		589.15
Electric-light receipts.....	497.78	52,254.09	5,861.17		58,613.04
Sales of scrap.....		112,923.85			112,923.85
Duties on scrap.....		1,720.68			1,720.68
Miscellaneous.....		1,125.39	683.54		1,808.93
Overpayments and corrections.....			44.64		5,172.82
Adjustment of cement rates.....		28,672.46		5,128.18	38,694.01
Overcharge construction relocation Panama R. R.....				147,009.35	147,009.35
Total.....	2,134,382.67	4,180,744.42	102,406.66	175,099.29	5,804,633.04

<sup>1</sup> Detailed statement of collections as required by section 3, act of Aug. 24, 1912.<sup>2</sup> This amount is made up of both cash collections and pay-roll deductions from employees.

TABLE 10.—Detailed statement of collections repaid to appropriations during the fiscal year ending June 30, 1913, and balance of fiscal year collections returnable to appropriations but not repaid during the year.

Nature of collections.	From employees (act of Mar. 4, 1907).	From outside parties (act of Aug. 24, 1912).	From other departments of the Government.	From over-payments and miscellaneous items.	Total repayments.	Balance of collections fiscal year 1913 returnable but not repaid.
Sale of property.....	\$18,884.78	\$2,347,127.12	\$31,643.05	\$12,940.21	\$2,410,595.16	\$163,924.24
Panama water rents.....		125,245.96			125,245.96	
Colon water rents.....		88,457.79			88,457.79	
Zone water rents.....			5,743.31		5,743.31	
Rentals, miscellaneous.....		43,558.08			43,558.08	2,209.25
Labor furnished Panama R. R. Co.....		659,983.44			659,983.44	25,078.94
Other labor furnished.....	2,436.46	141,425.10	49,025.70		192,887.26	11,428.89
Sale of hotel books.....	5,152.48	284,623.30			289,775.78	32,859.60
Hotel and boarding-camp receipts.....	1,165,804.96	67,681.34			1,233,486.30	5,009.62
Hospital receipts.....	127,068.09	73,027.55	1,169.34		201,264.98	7,610.52
Laundry receipts.....	10,791.53	6,119.64	39.48		16,950.65	554.50
Quarantine receipts.....	523.53	20,812.97			21,336.50	2,154.82
Corral receipts.....	14,101.55	63,866.02	8,130.98		86,098.55	2,767.19
Telegraph and telephone receipts.....	935.28	655.81	25.45		1,616.54	
Transportation.....	186.23	488.76	40.00		714.99	322.92
Electric-light receipts.....	497.78	50,686.31	5,861.17		57,045.26	2,520.62
Sales of scrap.....		66,249.85			66,249.85	46,674.00
Duties on scrap.....		1,720.68			1,720.68	
Miscellaneous.....		1,138.19	683.54		1,821.73	
Overpayments and corrections.....			44.64	5,128.18	5,172.82	
Adjustment of cement rates.....		28,672.46		10,021.55	38,694.01	
Overcharge construction relocation Panama R. R.....				147,009.35	147,009.35	
Total.....	1,346,382.67	4,071,540.37	102,406.66	175,099.29	5,695,428.99	1303,145.11

<sup>1</sup> See Table 2.

TABLE 11.—Statement of collections made on pay rolls of the Isthmian Canal Commission during the fiscal year ending June 30, 1913, as authorized by section 8 of the act of Mar. 4, 1907.

Months.	Total.	Commissary coupon books.	Hotel coupon books.	Subsistence.	Lost metal checks.	Transportation.	Medical service.	Bills collectible.	Miscellaneous.
GOLD ROLLS.									
1912—July.....	\$136,586.58	\$91,387.50	\$36,144.60	\$0.60	\$16.00	\$90.00	\$3,161.63	\$837.42	\$4,948.83
August.....	133,790.26	89,022.50	33,976.87	.....	21.00	60.00	3,175.98	1,137.58	4,376.33
September.....	133,560.10	89,790.97	38,177.22	.....	24.00	190.00	2,818.28	443.92	2,216.41
October.....	132,062.11	86,565.00	39,730.89	82.30	25.50	.....	2,993.09	443.92	2,221.41
November.....	127,872.14	81,002.50	40,761.06	.....	22.50	60.00	3,223.03	648.88	2,154.17
December.....	127,073.93	80,735.00	41,023.55	1.20	26.50	15.00	2,556.01	556.27	2,160.40
1913—January.....	132,677.48	91,695.25	35,386.47	1.20	19.50	160.00	2,558.38	841.42	2,014.26
February.....	120,569.48	80,802.30	35,214.00	4.80	16.00	120.00	2,083.52	677.30	1,651.56
March.....	114,182.15	76,747.98	32,110.60	41.10	19.00	120.00	2,453.45	1,183.19	1,506.83
April.....	118,333.72	79,093.33	34,046.10	6.30	21.00	30.00	2,708.32	1,124.13	1,404.54
May.....	118,740.80	79,347.50	34,629.74	23.40	18.00	.....	2,320.38	742.22	1,659.56
June.....	115,714.87	78,576.14	32,134.75	10.80	15.00	20.00	2,693.40	833.25	1,411.53
Total.....	1,511,163.62	1,004,765.97	435,335.85	171.70	244.00	865.00	32,746.47	9,309.08	27,725.55
SILVER ROLLS.									
1912—July.....	208,927.76	167,318.88	129.60	39,538.05	249.00	.....	607.20	9.30	1,075.73
August.....	211,793.64	169,367.60	99.60	40,823.76	271.98	34.70	694.62	14.10	1,405.28
September.....	218,947.79	174,887.91	144.00	42,616.16	278.00	21.30	599.84	10.70	418.98
October.....	212,963.71	175,275.37	163.80	35,837.13	290.18	45.75	853.68	.....	477.80
November.....	219,208.94	178,662.67	163.20	38,834.45	302.40	37.15	672.80	.....	536.27
December.....	217,710.08	177,985.14	129.00	38,184.63	284.50	.....	645.83	9.86	471.00
1913—January.....	238,095.30	201,941.94	114.60	37,434.10	267.29	.....	777.16	.67	550.54
February.....	212,816.13	175,697.80	104.40	35,185.00	311.30	30.00	550.55	.93	535.95
March.....	211,606.91	175,518.13	78.80	34,703.62	291.00	10.00	531.43	.....	472.82
April.....	226,438.05	189,432.47	83.40	35,346.73	308.84	15.58	671.70	10.02	563.31
May.....	228,477.50	182,884.08	60.00	34,053.94	326.30	.....	624.30	2.08	544.60
June.....	238,112.77	201,145.83	69.60	35,410.79	303.50	.....	667.43	11.72	563.90
Total.....	2,644,598.58	2,180,047.82	1,347.00	444,970.40	3,485.59	194.48	7,828.54	69.38	6,655.37
Grand total of collections.....	4,155,762.20	3,184,813.79	436,682.85	445,142.10	3,729.59	1,059.48	40,575.01	9,378.46	34,380.92
Collected for Panama R. R. Co. and various individuals.....	3,198,920.75	3,184,813.79	.....	.....	.....	.....	.....	.....	14,106.96
Returnable to appropriations (Table 9).....	956,841.45	.....	436,682.85	445,142.10	3,729.59	1,059.48	40,575.01	9,378.46	20,273.96

TABLE 12.—Statement of audited pay rolls on Isthmus during fiscal year 1913.

	Total pay rolls.	Officers and employees.		Skilled and unskilled labor.		Seacoast batteries.		Miscellaneous material purchases. <sup>1</sup>		Canal connecting Atlantic and Pacific Oceans. <sup>2</sup>	
		Amount.	Per cent of total.	Amount.	Per cent of total.	Amount.	Per cent of total.	Amount.	Per cent of total.	Amount.	Per cent of total.
Chairman and chief engineer.....	\$6,803,352.54	\$1,285,831.66	18.90	\$5,443,390.02	80.01			\$61,030.86	0.90	\$13,100.00	0.19
Atlantic division.....	3,120,340.31	650,188.16	20.84	2,470,172.15	79.16						
Central division.....	4,198,612.37	623,788.14	14.91	3,572,824.43	85.09						
Fortifications division.....	740,183.38					\$740,183.38	100.00				
Mechanical division.....	2,455,663.14	288,724.02	11.76	2,166,939.12	88.24						
Quartermaster's department.....	1,234,155.25	411,400.33	33.33	822,754.72	66.67						
Subsistence department.....	1,219,625.50	83,740.39	38.13	135,885.11	61.87						
Examiner of accounts.....	207,376.66	207,035.51	99.84	341.15	.16						
Disbursing officer.....	62,850.09	62,850.09	100.00								
Personal-injury claims.....	171,841.22	16,791.31	9.77	148,363.64	86.34	6,686.27	3.89				
Total construction and engineering.....	19,214,000.66	3,632,323.81	18.90	14,700,670.34	76.82	746,869.65	3.89	61,030.86	.32	13,100.00	.07
Sanitary department.....	881,851.73	678,222.30	76.91	203,629.43	23.09						
Personal-injury claims.....	655.41	479.50	73.16	175.91	26.84						
Total sanitary department.....	882,507.14	678,701.80	76.91	203,805.34	23.09						
Department of civil administration.....	584,806.08	562,678.24	96.22	22,127.84	3.78						
Personal-injury claims.....	1,619.37	1,492.25	92.15	127.12	7.85						
Total department of civil administration.....	586,425.45	564,170.49	96.20	22,254.96	3.80						
Total, all departments.....	20,682,933.25	4,875,202.10	23.57	14,986,730.64	72.46	746,869.65	3.61	61,030.86	.30	13,100.00	.06

<sup>1</sup> Lock-gate inspection.<sup>2</sup> Joint land commission.

TABLE 13.—Statement of bills collectible registered during the fiscal year ending June 30, 1913.

	Number of bills registered.	Total.	Against the Panama R. R.	Against the Canal Zone government.	Against the Republic of Panama.	Against other departments of United States Government.	Against other individuals and companies.	Memorandum bills registered after collections are made.	
								For pay-roll deductions.	For cash remitted by hotels, hospitals, etc.
1912—July.....	601	\$824,310.07	\$263,738.86	\$12,630.75	\$8,009.90	\$3,947.41	\$35,866.44	\$344,664.92	\$65,451.79
August.....	744	975,390.59	341,416.98	14,094.73	5,750.87	7,746.85	41,883.51	344,390.18	23,098.47
September.....	439	543,437.40	106,384.44	3,498.00	17,006.26	5,322.85	38,228.59	352,151.11	19,887.94
October.....	649	681,628.77	203,259.05	12,641.83	4,632.87	7,178.47	36,590.94	344,581.00	72,718.01
November.....	750	886,663.24	435,157.85	20,570.32	4,539.32	5,894.39	42,764.28	346,430.88	25,346.20
December.....	550	516,937.49	63,404.65	14,570.81	4,629.08	4,990.39	44,776.97	344,193.99	40,409.40
1913—January.....	750	795,019.19	246,447.30	5,733.87	1,017.38	5,515.60	65,540.59	369,923.87	100,778.58
February.....	950	1,045,881.98	556,710.18	24,530.40	8,498.61	7,203.57	38,010.84	332,198.89	58,729.49
March.....	700	723,078.22	232,038.55	25,381.01	6,351.60	6,813.88	63,815.26	324,600.72	64,077.20
April.....	599	706,626.98	210,141.03	8,797.58	5,605.64	7,116.57	39,510.79	343,729.05	91,725.72
May.....	900	863,514.70	257,229.70	55,978.03	7,554.72	7,909.05	153,781.14	346,474.00	34,588.06
June.....	651	687,228.36	241,531.50	15,248.93	6,402.32	6,527.10	31,618.85	352,962.42	32,937.24
Total.....	8,303	9,253,716.99	3,456,460.69	215,696.86	80,018.57	73,085.94	652,391.90	4,146,314.93	629,748.10

TABLE 14.—Statement of hotel coupons and meal tickets honored during the fiscal year ending June 30, 1913.

Month	Kitchens.				Messes.				Hotels, 30-cent coupons.		Cash collections at hotels.	Department and individual charges.
	9-cent tickets.		27-cent tickets.		13-cent tickets.		40-cent tickets.		Number.	Value.		
	Number.	Value.	Number.	Value.	Number.	Value.	Number.	Value.				
1912—July.....	1,121	\$100.89	38,646	\$10,434.42	1,745	\$232.67	86,231	\$34,492.40	172,232	\$51,669.60	\$15,133.55	\$2,647.07
August.....	850	76.50	39,365	10,628.55	2,378	317.07	82,316	32,926.40	176,463	52,938.90	10,868.10	2,797.27
September.....	515	46.35	37,250	10,057.50	1,746	232.80	78,183	31,273.20	179,127	53,738.10	12,899.60	2,839.53
October.....	632	56.88	35,958	9,708.66	2,366	315.47	81,196	32,478.40	199,115	59,734.50	13,717.87	2,656.08
November.....	857	77.13	34,170	9,225.90	2,031	270.80	77,600	31,040.00	197,229	59,168.70	16,159.81	3,281.24
December.....	870	78.30	31,114	8,400.78	2,501	333.47	73,937	29,574.80	209,299	62,789.70	24,301.38	2,762.77
1913—January.....	1,082	97.38	33,264	8,981.28	3,175	423.33	77,106	30,842.40	213,208	63,962.40	38,346.73	2,380.77
February.....	1,252	112.68	35,571	9,604.17	2,891	385.47	70,125	28,050.00	196,188	58,856.40	48,542.76	1,795.45
March.....	1,869	78.21	34,406	9,289.62	2,977	396.93	73,892	29,556.80	216,589	64,976.70	49,124.51	2,780.31
April.....	648	58.32	33,068	8,928.36	2,993	399.07	72,388	29,955.20	211,288	63,386.40	25,105.39	1,475.23
May.....	581	52.29	32,985	8,905.95	2,698	359.73	74,596	29,838.40	210,937	63,281.10	17,369.04	1,647.55
June.....	698	62.82	33,158	8,952.66	2,453	327.07	71,131	28,452.40	199,161	59,748.30	13,753.24	1,657.62
Total.....	9,975	\$97.75	418,955	113,117.85	29,954	3,993.88	918,701	367,480.40	2,380,836	714,250.80	285,321.98	28,729.82

TABLE 15.—*Statement of commissary and hotel coupon books and meal tickets issued during fiscal year ending June 30, 1913.*

	Commissary coupon books.					
	\$2.50 books.		\$5 books.		\$15 books.	
	Number.	Value.	Number.	Value.	Number.	Value.
1912—July.....	12,079	\$30,197.50	29,128	\$145,640.00	5,583	\$83,745.00
August.....	12,456	31,140.00	30,260	151,300.00	5,577	83,655.00
September.....	12,662	31,655.00	30,353	151,765.00	5,313	79,695.00
October.....	13,000	32,500.00	30,916	154,580.00	4,936	74,040.00
November.....	12,685	31,712.50	30,745	153,725.00	4,978	74,670.00
December.....	12,923	32,307.50	35,121	175,605.00	5,816	87,240.00
1913—January.....	12,579	31,447.50	30,425	152,125.00	4,926	73,890.00
February.....	12,352	30,880.00	30,297	151,485.00	4,733	70,995.00
March.....	12,996	32,490.00	32,693	163,465.00	4,909	73,635.00
April.....	13,812	34,530.00	32,784	163,920.00	4,990	74,850.00
May.....	13,918	34,795.00	34,465	172,325.00	4,903	73,545.00
June.....	14,303	35,757.50	34,453	172,265.00	4,784	71,760.00
Total.....	155,765	389,412.50	381,640	1,908,200.00	61,448	921,720.00

	Hotel coupon books.				Meal tickets.			
	\$4.80 books.		\$15 books.		27-cent tickets.		40-cent tickets.	
	Num-ber.	Value.	Num-ber.	Value.	Num-ber.	Value.	Num-ber.	Value.
1912—July.....	400	\$1,920.00	2,700	\$40,500.00	39,800	\$10,746.00	92,900	\$37,160.00
August.....	1,425	6,840.00	5,795	86,925.00	25,400	6,858.00	60,800	24,320.00
September.....	1,100	5,280.00	3,420	51,300.00	35,000	9,450.00	92,600	37,040.00
October.....	470	2,256.00	3,280	49,200.00	27,000	7,290.00	62,700	25,080.00
November.....	1,585	7,608.00	4,910	73,650.00	64,200	17,334.00	105,300	42,120.00
December.....	475	2,280.00	8,390	125,850.00	30,200	8,154.00	70,100	28,040.00
1913—January.....	445	2,136.00	3,405	51,075.00	23,500	6,345.00	79,500	31,800.00
February.....	620	2,976.00	2,170	32,550.00	23,900	6,453.00	63,500	25,400.00
March.....	430	2,064.00	2,944	44,160.00	22,800	6,156.00	51,900	20,760.00
April.....	300	1,440.00	3,815	57,225.00	36,300	9,801.00	66,400	26,560.00
May.....	465	2,232.00	9,406	141,090.00	58,000	15,660.00	127,500	51,000.00
June.....	545	2,616.00	2,295	34,425.00	20,000	5,400.00	47,200	18,880.00
Total.....	8,260	39,648.00	52,530	787,950.00	406,100	109,647.00	920,400	368,160.00

NOTE.—The above figures represent the total of commissary coupon books issued to Isthmian Canal Commission employees, collection for which has been made on the pay rolls.

Totals of hotel coupon books and meal tickets represent all the books and tickets distributed on the Isthmus for issue to the employees of the commission, Panama R. R. Co., and contractors.





TABLE 17.—*Statement of amounts paid, under act of May 30, 1908, to employees as compensation and on account of death of employees injured in course of employment, July 1, 1912, to June 30, 1913; and amounts paid, under act of Feb. 24, 1909, for injuries lasting 15 days or less.*

Department or division.	July.	August.	September.	October.	November.	December.	January.	February.
Atlantic:								
Injuries.....	\$1,977.21	\$2,750.66	\$1,894.31	\$2,291.84	\$2,196.75	\$1,930.65	\$2,687.69	\$1,790.95
Deaths.....	522.66	452.67	433.06	1,286.93	750.84	672.70	400.52	1,144.12
Central:								
Injuries.....	3,345.85	4,346.36	3,320.22	3,297.06	3,056.39	3,262.01	3,490.86	3,091.56
Deaths.....	188.18	419.45	461.32	782.94	262.46	175.70	121.05	537.51
Pacific:								
Injuries.....	2,549.27	3,384.32	4,038.34	4,400.16	3,744.34	3,238.29	.....	.....
Deaths.....	911.20	771.57	596.41	239.93	314.54	729.73	.....	.....
Mechanical:								
Injuries.....	1,312.44	2,982.24	1,563.54	1,229.04	1,819.53	836.70	1,402.15	1,566.77
Deaths.....	250.32	250.32	220.00	99.36	211.12	95.68	204.64	88.32
Quartermaster:								
Injuries.....	378.83	155.81	495.47	452.60	237.90	267.62	602.11	222.79
Deaths.....	68.25	60.76	53.99	69.08	44.55	56.24	.....	34.39
Sanitary:								
Injuries.....	.....	39.80	34.04	26.50	29.67	16.50	12.80	40.00
Deaths.....	.....	.....	.....	.....	.....	.....	.....	.....
Civil administration:								
Injuries.....	286.44	211.38	207.06	316.25	179.24	40.00	40.00	134.17
Deaths.....	.....	.....	.....	.....	.....	.....	.....	.....
Subsistence:								
Injuries.....	12.25	.....	.....	36.51	7.08	10.63	8.50	.....
Deaths.....	.....	.....	.....	.....	.....	.....	.....	.....
Disbursing:								
Injuries.....	215.83	175.00	99.17	163.33	175.00	87.50	175.00	175.00
Deaths.....	.....	.....	.....	.....	.....	.....	.....	.....
Fortifications:								
Injuries.....	252.75	145.32	864.89	761.20	502.34	184.47	932.19	493.57
Deaths.....	.....	.....	156.96	28.31	206.15	27.59	90.75	258.76
First division:								
Injuries.....	437.98	461.37	1,021.77	464.80	593.47	825.65	1,703.99	988.51
Deaths.....	.....	.....	.....	.....	.....	.....	69.16	264.40
Second division:								
Injuries.....	.....	.....	.....	.....	71.50	.....	929.93	234.40
Deaths.....	.....	.....	.....	.....	.....	.....	.....	.....
Fourth division:								
Injuries.....	.....	.....	.....	.....	.....	.....	.....	12.91
Deaths.....	.....	.....	.....	.....	.....	.....	.....	.....
Fifth division:								
Injuries.....	.....	.....	.....	.....	.....	.....	3,815.84	2,491.95
Deaths.....	.....	.....	.....	.....	.....	.....	871.13	461.55
Sixth division:								
Injuries.....	.....	.....	.....	.....	.....	.....	837.99	350.42
Deaths.....	.....	.....	.....	.....	.....	.....	.....	.....
Examiner of accounts:								
Injuries.....	.....	.....	.....	.....	.....	.....	.....	.....
Deaths.....	.....	.....	.....	.....	.....	.....	.....	.....
Total.....	13,009.46	16,607.03	15,460.55	15,945.84	14,402.87	12,457.66	18,396.30	14,382.05

TABLE 17.—Statement of amounts paid, under act of May 30, 1908, to employees as compensation and on account of death of employees injured in course of employment, July 1, 1912, to June 30, 1913; and amounts paid, under act of Feb. 24, 1909, for injuries lasting 15 days or less—Continued.

Department or division.	March.	April.	May.	June.	Total injury and death payments.	Total under act Feb. 24, 1909.	Grand total.
Atlantic:							
Injuries.....	\$2,657.70	\$2,008.35	\$1,700.35	\$1,682.39	\$25,568.85	\$6,984.08	.....
Deaths.....	176.88	537.20	99.51	485.04	6,962.13		\$39,515.06
Central:							
Injuries.....	2,932.60	2,445.90	2,882.77	2,791.11	38,262.69	10,039.76	.....
Deaths.....	143.69	186.85	239.26	607.47	4,125.88		52,428.33
Pacific:							
Injuries.....					21,654.72	6,678.29	.....
Deaths.....					3,563.38		31,896.39
Mechanical:							
Injuries.....	1,299.88	1,033.72	1,228.67	1,583.89	17,858.57	12,369.39	.....
Deaths.....	410.64	588.15	263.83	275.94	2,958.32		33,186.28
Quartermaster:							
Injuries.....	297.63	275.84	360.61	185.17	3,932.38	1,030.73	.....
Deaths.....					387.26		5,350.37
Sanitary:							
Injuries.....	31.00	242.50	168.00	14.60	655.41	204.86	.....
Deaths.....							860.27
Civil administration:							
Injuries.....	105.50	54.33	42.00	3.00	1,619.37	214.69	.....
Deaths.....							1,834.06
Subsistence:							
Injuries.....		26.67	12.50	6.88	121.02	86.45	.....
Deaths.....							207.47
Disbursing officer:							
Injuries.....		350.00	175.00	175.00	1,965.83		.....
Deaths.....							1,965.83
Fortifications:							
Injuries.....	503.91	264.55	374.25	231.92	5,511.36	1,750.21	.....
Deaths.....	93.56	93.29	190.29	29.25	1,174.91		8,436.48
First division:							
Injuries.....	842.13	582.46	1,207.30	814.58	9,944.01	4,792.11	.....
Deaths.....	43.44	46.56	47.84	166.96	638.36		15,374.48
Second division:							
Injuries.....	326.43	429.36	315.21	1,045.63	3,352.46		.....
Deaths.....							3,352.46
Fourth division:							
Injuries.....			115.00		127.91		.....
Deaths.....							127.91
Fifth division:							
Injuries.....	2,746.03	2,241.68	2,529.31	2,450.13	16,274.94	3,961.08	.....
Deaths.....	678.43	305.45	1,485.80	179.42	3,981.78		24,217.80
Sixth division:							
Injuries.....	828.26	737.14	813.52	526.94	4,094.27	1,113.83	.....
Deaths.....							5,208.10
Examiner of accounts:							
Injuries.....							.....
Deaths.....						110.43	110.43
Total.....	14,117.71	12,450.00	14,251.02	13,255.32	174,735.91	49,335.91	224,071.72

*Total payments, made by fiscal years, to date.*

	Injuries.	Deaths.	Under act of Feb. 24, 1909.	Total.
From Aug. 1, 1908, to June 30, 1909.....	\$32,355.71	\$3,682.79	\$8,225.16	\$44,263.66
From July 1, 1909, to June 30, 1910.....	96,810.33	21,053.22	16,010.30	133,873.85
From July 1, 1910, to June 30, 1911.....	168,416.23	35,248.39	49,957.80	253,622.42
From July 1, 1911, to June 30, 1912.....	166,620.21	37,534.68	55,838.25	259,993.14
From July 1, 1912, to June 30, 1913.....	150,943.79	23,792.02	49,335.91	224,071.72
	615,146.27	121,311.10	179,367.42	915,824.79
Payments made under special acts of Congress.....				29,707.38
Total.....				945,532.17

TABLE 18.—*Number of fatal and nonfatal accidents reported from each specified cause, for the fiscal years 1908-9, 1909-10, 1910-11, and 1911-12.*

Cause of injury.	1908-9		1909-10		1910-11		1911-12	
	Non-fatal.	Fatal.	Non-fatal.	Fatal.	Non-fatal.	Fatal.	Non-fatal.	Fatal.
Motors.....	9	4	1	7	1	1	1	1
Power-transmission apparatus.....	27	1	44	1	52	1	1	1
Working machinery using power.....	106	91	1	193	91	1	1	1
Working machinery not using power.....	7	9	18	11	11	1	1	1
Elevators, hoists, cranes, etc.....	61	1	140	9	266	5	111	5
Steam boilers, piping, explosions, etc.....	43	4	53	1	53	1	7	1
Explosions of dynamite, powder, etc.....	159	44	51	4	35	9	66	11
Inflammable, poisonous, hot, corrosive materials, gases, vapors, etc.....	31	1	96	1	144	43	43	1
Electric current.....	3	1	21	5	25	6	11	4
Collapse, fall, etc., of materials, etc.....	531	10	535	7	738	15	271	7
Falls from ladders, stairs, scaffolding, etc., or into excavations.....	91	2	188	5	327	10	114	5
Falls on even surface.....	56	1	167	132	146	146	146	146
Loading and unloading, lifting, carrying, etc.....	280	5	542	1	1,214	371	371	2
Vehicles (run over by wagons, carts, etc.).....	15	1	14	57	8	8	8	8
Railway operation (run over, etc.).....	248	41	332	38	488	42	292	37
Animals (kicks, bites, etc.) and riding.....	15	14	9	9	4	4	4	1
Shipping and water transportation.....	38	8	32	9	58	8	38	6
Flying bodies, splinters, etc.....	16	383	667	2	66	66	66	66
Hand tools and simple instruments.....	230	251	465	1	153	153	153	1
Stepping on nails and similar sharp bodies.....	55	102	225	44	44	44	44	44
Other causes.....	87	2	206	3	192	4	101	5
Cause not reported.....	1	1	7	11	1	1	1	1
Total.....	2,107	119	3,233	85	5,376	105	1,949	86

NOTE.—In fiscal year ending June 30, 1912, there were 5,141 cases of accidents resulting in incapacity lasting less than 15 days and paid for as meritorious sick leave.

TABLE 19.—*Number of compensated cases of nonfatal injuries for the fiscal years 1908-9, 1909-10, 1910-11, and 1911-12.*

Nature of injury.	1908-9	1909-10	1910-11	1911-12
Upper extremities:				
Loss of either arm, not specified.....	1	2	1	4
Loss of right arm.....		3	2	1
Fracture of arm or forearm.....	19	30	38	27
Other injuries to either arm or forearm.....	16	26	31	74
Loss of hand, not specified.....		2	1	1
Loss of right hand.....				4
Fracture of bones of hand.....	7	24	23	13
Other injuries to hand.....	29	70	53	105
Loss of 1 finger, right hand.....	7	26	17	89
Loss of 1 finger, left hand.....	2	16	20	100
Loss of more than 1 finger, right hand.....	4	6	10	8
Loss of more than 1 finger, left hand.....		5	9	12
Either hand, not specified.....	28	5		1
Fracture of fingers.....	44	63	81	34
All other injuries to fingers.....	62	83	154	232
All other injuries to upper extremities.....	11	8	1	2
Lower extremities:				
Loss of either leg.....	7	13	12	7
Loss of both legs.....	2	2	3	5
Fracture of either thigh.....	11	5	5	1
Fracture of either leg.....	24	39	58	76
Fracture of both thighs or legs.....	1			4
Other injuries to thigh or legs.....	81	121	140	235
Loss of foot.....	6	2	3	1
Fracture of bones of foot.....	51	68	69	44
Other injuries to foot.....	82	123	173	305
Loss of toe or toes.....	3	11	9	3
All other injuries to lower extremities.....	37	16	8	4
Combined injuries to upper and lower extremities:				
Including loss of any part.....	1	1		2
Including fractures.....	3	1		1
All other injuries to the extremities.....	5	6	6	4
Trunk:				
Fracture of ribs.....	10	15	12	22
Other chest injuries.....	5	18	10	8
Injuries to back.....	15	20	14	27
Hernia.....	42	92	103	169
Other abdominal injuries.....	6	5	5	5
All other injuries to trunk.....	14	7	32	77
Eyes:				
Loss of either eye.....	4	5	8	
Other injuries to either eye.....	20	37	30	56
Loss of both eyes.....		2		
Other injuries to both eyes.....		4	3	11
Head:				
Fracture of skull.....	2	7	6	26
Fracture of other bones.....	3	7	4	8
Concussion of brain, without fracture.....	1	2		3
All other injuries to head.....	8	20	15	49
Neck:				
All injuries.....		2	1	5
Miscellaneous:				
Internal injuries.....	1	1	2	14
Poisoning.....				9
All other (including multiple injuries).....	41	84	80	67
Not reported.....	1		1	
Total.....	717	1, 105	1, 253	1, 949

TABLE 20.—*Revenues collected, Canal Zone funds, from July 1, 1912, to June 30, 1913.*

[This statement includes balances in hands of collecting officers but does not include money orders, Isthmian Canal Commission clubhouses, nor trust funds.]

On account of—	Administrative districts.				
	Ancon.	Empire.	Gorgona.	Cristobal.	Total.
Animal license.....	\$22.50	\$231.30	\$52.50	\$147.00	\$453.30
Aerated waters.....	638.40	3,078.00	148.40	1,512.40	5,377.20
Bicycle license.....	141.75	141.75	61.75	141.75	487.00
Building rental.....	3,617.75	3,666.50	417.00	.....	7,701.25
Burial permits.....	595.05	595.05	74.50	595.05	1,859.65
Cabs and coaches.....	.....	202.00	.....	.....	202.00
Carts.....	426.00	1,069.50	20.50	794.50	2,310.50
Circuit-court collections.....	3,110.35	3,110.35	305.99	3,110.33	9,637.02
Chauffeur's license.....	39.34	39.33	4.00	39.33	122.00
Corporation tax.....	33.33	33.34	.....	33.33	100.00
District-court collections.....	7,252.52	11,138.37	566.34	7,266.04	26,223.27
Dance halls.....	.....	40.00	.....	20.00	60.00
Distilling license.....	3,331.70	3,174.50	2,624.35	.....	9,130.55
Escheated estates.....	2.50	2.50	.....	2.50	7.50
Gathering coconuts.....	.....	.....	.....	140.75	140.75
Hucksters.....	.....	.....	.....	49.60	49.60
Hunting permits.....	502.08	502.09	128.75	502.08	1,635.00
Insurance tax.....	389.29	389.28	12.50	389.31	1,180.38
Interest.....	10,862.57	10,862.58	60.05	10,862.57	32,647.77
Land rental.....	413.38	3,221.42	27.25	69.90	3,731.95
Market rental.....	414.20	3,057.10	100.40	257.40	3,829.10
Motor-vehicle license.....	502.65	502.67	120.88	502.67	1,628.87
Merchandise and drugs.....	756.60	4,029.71	178.90	1,681.10	6,646.31
Marshal fees.....	324.05	590.05	85.40	634.28	1,633.78
Navigator license.....	50.00	50.00	.....	50.00	150.00
Peddling.....	1,524.00	4,227.50	167.50	2,310.00	8,229.00
Physician's license.....	30.83	30.84	2.50	30.83	95.00
Public entertainment.....	27.00	784.40	2.50	489.40	1,303.30
Poll tax.....	92.40	80.80	.....	129.20	302.40
Pound fees.....	83.12	122.01	15.50	109.94	330.57
Police fines.....	47.41	47.43	1.75	47.41	144.00
Restaurants.....	241.20	552.40	29.80	403.60	1,227.00
Retail liquor license.....	.....	16,600.00	.....	4,800.00	21,400.00
Retail sale tobacco.....	676.40	3,966.80	206.40	1,693.60	6,543.20
Real estate tax.....	3,147.70	2,076.12	189.60	1,801.98	7,215.40
Sale of property.....	177.13	177.14	.....	177.13	531.40
Sale impounded animals.....	.....	6.00	.....	11.00	17.00
Sale imported meats.....	7.67	127.37	13.13	68.22	216.39
School tuition, lost or damaged books.....	287.65	287.66	9.25	287.66	872.22
Service district prisoners.....	26.34	14.42	.....	7.00	47.76
Slaughter tax.....	87.50	8,357.50	75.50	1,294.50	9,815.00
Steamboat inspection.....	902.06	902.07	32.36	902.06	2,738.55
Water tax.....	2,038.80	17,960.95	11.50	14,282.64	34,293.89
Total.....	42,823.22	106,048.80	15,746.75	57,648.06	212,266.83
Stamp sales.....	.....	.....	.....	.....	100,451.79
Stamp-book sales.....	.....	.....	.....	.....	466.20
Sale of mail matter.....	.....	.....	.....	.....	52.20
Money-order fees.....	.....	.....	.....	.....	23,347.12
Exchange Martinique money-order business.....	.....	.....	.....	.....	19.19
					336,603.33

¹ Consolidated with Empire district Sept. 1, 1912.

TABLE 21.—*Expenditures, Canal Zone funds, July 1, 1912, to June 30, 1913.*

[This statement includes all outstanding audited claims, but does not include expenditures of money orders, Isthmian Canal Commission clubhouses, nor trust funds.]

On account of—	Administrative districts.				Total.
	Ancon.	Empire.	Gorgona.	Cristobal.	
PUBLIC IMPROVEMENTS.					
Roads and trails:					
Construction.....	\$5,059.84	\$32,724.47		\$3,960.98	\$41,745.29
Maintenance.....	23,859.78	14,780.05		2,673.59	41,313.42
Market houses:					
Construction.....		98.84			98.84
Maintenance.....	8.67	539.23		19.15	567.05
Operation.....	580.17	765.41	\$62.19	495.17	1,902.94
Slaughterhouses:					
Construction.....	91.47				91.47
Maintenance.....		54.71			54.71
Operation.....	530.41	484.56	62.18	483.09	1,560.24
Waterworks and sewers:					
Construction.....	13.93	1,042.49		475.30	1,531.72
Maintenance.....	3.82	1,811.60		724.44	2,539.86
Sanitation native villages, maintenance...	5,500.00	7,000.00		5,500.00	18,000.00
Street lighting.....	16.73	891.07		286.86	1,194.66
Miscellaneous public works, maintenance..		281.95		22.35	304.30
PUBLIC SCHOOLS.					
Schoolhouses:					
Construction.....	1,626.01			227.70	1,853.71
Maintenance.....	594.46	529.29		1,144.21	2,267.96
Salaries—superintendent, teachers, and clerks.....	21,206.45	21,206.47	1,812.36	21,206.47	65,431.75
Janitor service.....	982.91	2,204.72	18.00	1,359.15	4,564.78
Furniture and equipment.....	466.88	636.17		491.82	1,594.87
Supplies.....	2,268.71	2,037.94		1,863.10	6,169.75
Traveling and miscellaneous expenses.....	3,617.23	3,643.29	1.71	3,192.22	10,454.45
MAINTENANCE ADMINISTRATIVE DISTRICTS.					
Salaries district judges.....	4,387.09	4,387.09	607.08	4,387.09	13,768.35
Supplies and miscellaneous.....	742.53	574.78		560.49	1,877.80
Zone charity cases, maintenance.....	1,090.30	1,080.50		1,074.00	3,244.80
District prisoners, maintenance.....	3,894.98	4,042.76		1,891.31	9,829.05
Total.....	76,542.37	100,817.39	1 2,563.52	52,038.49	231,961.77
CONTINGENT EXPENSES.					
Gratuity penitentiary prisoners.....					750.00
Miscellaneous postal service.....					586.37
Purchase of stamps.....					34,363.11
Transportation of mails:					
Isthmus.....					13,990.00
Ocean.....					27,859.11
Miscellaneous expenses.....					10,357.68
Transfer to Isthmian Canal Commission as reimbursement in part for salaries paid.					55,000.00
Total.....					374,868.04

<sup>1</sup> Consolidated with Empire district Sept. 1, 1912.

TABLE 22.—*Statement of balances in Treasury, by appropriations, June 30, 1913.*

Public improvements and schools.....	\$216,676.46
Miscellaneous and contingent.....	7,396.87
Postal receipts, 1913.....	13,260.42
Money-order funds.....	1,181,049.40
Isthmian Canal Commission clubhouse funds.....	25,814.56
Trust funds.....	9,059.60
Postal savings funds.....	634,958.00
Invalidated money orders.....	14,154.01
Total.....	2,103,269.32





Retail liquor licenses.....	2,513.92		40,800.00	72,800.00	65,040.00	97,300.00	48,089.88	21,400.00	347,643.80
Retail sale of tobacco.....				8,621.60	9,084.00	8,474.00	37,657.20	9,443.20	40,380.00
Real-estate tax.....		3,932.18	11,991.16	29,791.25	32,710.96	41,133.61	32,078.11	7,213.40	158,832.67
Sale of property.....			72.50	3,572.50	282.10	5,512.40	1,184.47	331.40	111,123.37
Sale of impounded animals.....				35.10	13.25	24.40	191.85	17.00	281.60
Sale of imported meats.....				437.82	545.21	315.91	62.56	216.39	1,577.89
School tuition, lost or damaged books.....		30.42	247.10	577.59	233.08	774.28	876.23	872.22	3,670.92
Stamp paper.....	240.11	76.20							316.31
Services district prisoners.....		149.80			867.85	6.40	31.86	47.76	1,103.67
Slaughter tax.....	1,547.46	4,697.55	13,449.00	12,894.00	15,496.00	17,634.50	12,395.00	9,815.00	87,928.51
Steamboat inspection.....							2,837.15	2,738.55	5,575.70
Water tax.....		470.95	2,994.37	7,535.80	12,962.45	20,531.70	30,012.89	34,293.89	108,802.05
Total revenues.....	10,070.13	12,043.50	40,362.20	247,547.88	286,608.75	320,891.63	259,759.68	212,266.83	1,581,410.77
Municipal funds, transferred.....			191,860.17	83,660.36					83,660.36
Postal receipts:									
Postage stamps.....	11,043.65	28,870.02	72,709.54	74,327.40	83,847.10	82,613.72	87,441.58	100,451.79	596,847.04
Stamp books.....							199.87	466.20	666.07
Sale of mail matter.....		197.25	19,309.14	21,720.93	22,957.29	23,457.98	22,871.68	52.20	52.20
Money-order fees.....								23,347.12	143,575.74
Exchange Martinique, money-order business.....								19.19	19.19
Total postal receipts.....	11,043.65	29,067.27	92,018.68	96,048.33	106,804.39	106,071.80	110,513.13	124,336.50	741,178.24
Summary of receipts:									
Revenues.....	10,070.13	12,043.50	40,362.20	247,547.88	286,608.75	320,891.63	259,759.68	212,266.83	1,581,410.77
Municipal funds.....			191,860.17	83,660.36					83,660.36
Postal receipts.....	11,043.65	29,067.27	92,018.68	96,048.33	106,804.39	106,071.80	110,513.13	124,336.50	741,178.24
Total receipts.....	21,113.78	41,110.77	367,539.21	343,596.21	393,413.14	426,963.33	370,272.81	336,603.33	2,406,249.37

TABLE 24.—*Expenditures from July 1, 1905, to June 30, 1913.*

[This statement includes all outstanding audited claims, but does not include expenditures of money order, clubhouses, nor trust funds.]

On account of—	July 1, 1905, to June 30, 1906.	July 1, 1906, to June 30, 1907.	July 1, 1907, to June 30, 1908.	July 1, 1908, to June 30, 1909.	July 1, 1909, to June 30, 1910.	July 1, 1910, to June 30, 1911.	July 1, 1911, to June 30, 1912.	July 1, 1912, to June 30, 1913.	Total.
<b>PUBLIC IMPROVEMENTS.</b>									
Roads and trails:									
Construction.....			\$2,271.16	\$66,601.60	\$191,003.66	\$34,588.54	\$46,105.01	\$41,745.29	\$382,315.26
Maintenance.....				4,669.61	15,208.75	15,362.52	19,639.50	41,313.42	96,133.80
Market houses:									
Construction.....			1,385.08	15,485.01	2,497.33	110.64		98.84	19,576.90
Maintenance.....			1,467.33	5,476.14	686.77	532.89	1,099.50	567.05	9,829.68
Operation.....			1,133.29	2,238.52	1,862.58	1,610.46	1,835.31	1,902.94	10,583.10
Slaughterhouses:									
Construction.....					197.82	776.88	18.02	91.47	1,084.19
Maintenance.....			221.97	1,576.68	224.67	393.93	66.20	54.71	2,538.16
Operation.....			325.00	1,027.96	1,309.25	1,500.00	1,622.09	1,560.24	7,344.54
Waterworks and sewers:									
Construction.....			4,279.53	16,561.44	25,011.23	2,203.54	2,034.79	1,531.72	51,622.25
Maintenance.....				315.85	1,904.16	682.86	4,669.53	2,539.86	10,112.26
Sanitation native villages.....			7,336.94	16,087.21	12,500.00			18,000.00	53,924.15
Street lighting.....			24.84	3,476.29	1,226.90		1,205.28	1,194.66	8,163.59
Miscellaneous public works:									
Construction.....			25,033.37	2,339.05	5,712.90		780.96		8,832.91
Maintenance.....				16,018.83	1,425.63	330.27	1,292.10	304.30	53,154.53
Total public improvements.....			43,538.51	151,874.19	260,771.65	59,068.15	80,368.29	110,904.50	715,215.32
<b>PUBLIC SCHOOLS.</b>									
Schoolhouses:									
Construction.....			5,298.65	56,752.89	12,877.07	13,082.86	8,230.79	1,853.71	98,095.97
Maintenance.....			5,577.72	11,220.16	2,814.99	2,305.56	3,483.62	2,267.96	23,137.29
Rental.....			390.00	599.16	1,160.00				1,701.66
Salaries, superintendent, teachers, and clerks.....			31,694.00	42,477.88	51,436.82	55,828.19	62,122.75	65,431.75	349,207.52
Janitor service.....			187.46	2,432.15	2,562.98	1,830.76	3,539.03	4,564.78	15,462.95
Furniture and equipment.....			25.00	3,383.02	1,925.07	1,535.26	8,030.65	1,584.87	16,888.44
Supplies.....			299.72	2,201.11	4,915.16	6,090.28	2,967.22	6,169.50	28,945.20
Traveling and miscellaneous.....			998.26	983.12	1,161.31	2,197.55	12,623.15	10,454.45	28,597.46
Total public schools.....			38,811.33	120,012.83	77,843.40	82,970.46	100,997.23	92,337.27	562,036.49



TABLE 25.—*Statement of receipts and disbursements, Canal Zone funds, May 1, 1904, to June 30, 1913.*

RECEIPTS.	
Revenues collected.....	\$1, 665, 071. 13
Postal receipts.....	741, 178. 24
Total collections.....	\$2, 406, 249. 37
DISBURSEMENTS.	
Expenditures:	
Public improvements.....	\$715, 215. 32
Public schools.....	562, 036. 49
Maintenance administrative districts.....	184, 274. 39
Miscellaneous and contingent.....	19, 722. 21
Postal service.....	685, 343. 89
Total disbursements.....	2, 166, 592. 30
Available for expenditure.....	239, 657. 07
TREASURY BALANCE, JUNE 30, 1913.	
Public improvements and schools.....	\$216, 676. 46
Miscellaneous and contingent.....	7, 396. 87
Postal receipts, 1913.....	13, 260. 42
	237, 333. 75
Collecting officers' balance.....	2, 226. 57
Postmasters' balance.....	120. 00
	239, 680. 32
Audited claims unpaid.....	23. 25
Balance available.....	239, 657. 07
SEPARATE STATEMENT COVERING POSTAL SERVICE.	
Receipts:	
Stamp sales.....	\$596, 847. 04
Stamp-book sales.....	666. 07
Sale of mail matter.....	52. 20
Money-order fees.....	143, 593. 74
Exchange Martinique money-order business.....	19. 19
	741, 178. 24
Disbursements:	
Balance of funds prior to Mar. 4, 1907, consolidated with regular Zone revenues.....	42, 453. 93
Purchase of stamps.....	240, 930. 13
Miscellaneous expenditures.....	225, 900. 55
Transfer to Isthmian Canal Commission as reimbursement in part for salaries paid.....	218, 531. 21
	727, 815. 82
Available for expenditure.....	13, 362. 42
Treasury balance.....	\$13, 260. 42
Postmasters' balance.....	120. 00
	13, 362. 42

## POSTAL SERVICE.

TABLE 26.—Statement showing total value of money orders issued, money orders paid, money orders outstanding, and balance of money-order funds, June 30, 1913.

Year ending June 30—	Money orders issued.	Money orders paid by—				
		United States.	Canal Zone.	Martinique.	Costa Rica.	Total.
1907.....	\$2,369,031.49	\$1,581,251.01	\$208,165.48	.....	.....	\$1,789,417.39
1908.....	4,086,684.98	2,875,719.61	1,017,750.97	.....	.....	3,893,470.58
1909.....	5,166,749.46	3,583,419.57	1,492,144.76	.....	.....	5,075,564.33
1910.....	5,228,553.60	4,068,650.16	1,331,568.20	\$2,267.60	.....	5,402,485.96
1911.....	5,304,906.60	3,725,996.12	1,337,915.09	6,022.08	.....	5,069,933.29
1912.....	4,915,077.26	3,521,511.95	1,280,397.88	8,176.95	\$1,062.40	4,811,149.18
1913.....	4,883,624.13	4,286,948.31	881,728.73	9,646.65	3,046.10	5,181,369.79
Total.....	32,654,627.52	23,643,497.63	7,549,671.11	26,113.28	4,108.50	31,223,390.52

## SUMMARY.

Total money orders issued.....	\$32,554,627.52
Total money orders paid.....	31,223,390.52
Total outstanding.....	1,331,237.00

## MONEY-ORDER FUNDS.

Cash in hand, Canal Zone treasurer.....	1,181,949.40
Cash in hands of postmasters.....	27,858.74
Cash in hands of Canal Zone treasurer, account of invalidated orders.....	14,154.01
Due from Costa Rica postal department.....	19.00
Due from United States Postal Department.....	109,738.39
Due Martinique postal department.....	2,482.54
Unpaid money orders outstanding.....	1,331,237.00
	1,333,719.54

TABLE 27.—Statement of money-order business and stamp sales fiscal year ended June 30, 1913.

Post offices.	Amount issued.	Money orders paid at Canal Zone post offices.				Postal receipts.	
		United States.	Canal Zone.	Marti- nique.	Costa Rica.	Money- order fees.	Stamp sales.
Ancon.....	\$639,267.13	\$14,646.06	\$98,890.04	\$513.64	\$143.45	\$3,246.85	\$18,644.01
Balboa.....	238,855.30	4,368.43	27,587.30	.....	.....	1,096.62	1,295.66
Bas Obispo.....	65,506.42	2,928.14	17,155.52	.....	.....	337.54	4,024.50
Corozal.....	318,065.75	4,160.67	62,029.92	.....	.....	1,342.11	1,805.00
Cristobal.....	895,739.57	20,057.60	179,059.61	28.15	30.50	4,194.63	3,785.00
Culebra.....	284,313.23	4,727.32	37,792.39	.....	.....	1,473.01	22,539.00
Empire.....	418,047.38	9,041.84	73,824.16	5.05	18.00	2,104.71	2 23.18
Gatun.....	610,109.64	7,477.41	130,830.06	.....	.....	2,965.51	6,563.00
Gorgona.....	429,917.09	6,823.59	57,299.70	.....	.....	1,915.89	9,225.00
Las Cascadas.....	171,475.34	7,567.93	23,331.26	.....	.....	840.66	12,266.00
Matachin.....	35,674.90	126.83	7,406.52	.....	.....	232.02	3,971.00
Miraflores.....	121,351.71	774.09	35,684.59	9.90	.....	569.51	5,180.00
Paraíso.....	218,488.93	2,435.74	45,021.04	.....	.....	1,041.95	2,115.00
Pedro Miguel.....	338,823.99	2,978.81	60,762.31	.....	.....	1,538.24	3,660.00
Station A.....	58,878.16	1,172.49	12,736.53	.....	.....	259.53	4,045.55
Station B.....	39,109.49	161.00	7,567.43	48.54	.....	188.34	681.00
District quartermaster, Mount Hope.....	.....	.....	.....	.....	.....	.....	543.75
Monte Lirio.....	.....	.....	.....	.....	.....	.....	255.00
Invalidated.....	.....	.....	4,750.35	.....	.....	2 19.19	195.00
Total.....	4,883,624.13	89,447.95	881,728.73	605.28	191.95	23,366.31	100,917.99

<sup>1</sup>Newspaper postage.<sup>2</sup>Exchange on draft to Martinique.

TABLE 28.—Statement showing the monthly money-order business of the Canal Zone postal service, fiscal year ended June 30, 1913.

Month.	Amount Issued.	Fees.	Money orders paid in Canal Zone post offices.				Canal Zone orders paid in—			Cash remittances to United States Post Office Department.
			United States.	Marti- nique.	Costa Rica.	Canal Zone.	Marti- nique.	Costa Rica.	United States.	
1912—July.....	\$409,929.00	\$1,936.12	\$9,607.43	\$0.63	\$30.00	\$101,671.59	.....	.....	\$1,151,144.39	\$233,000.00
August.....	365,073.51	1,703.92	6,579.55	.....	13.55	81,769.56	.....	.....	163,886.40	285,000.00
September.....	369,093.11	1,765.75	5,886.22	91.65	27.00	72,090.99	.....	\$1,125.65	348,271.85	240,000.00
October.....	393,950.89	1,856.68	7,694.19	.....	44.65	74,661.63	.....	.....	169,553.73	350,000.00
November.....	418,851.12	2,055.78	5,828.16	9.71	.....	71,219.58	.....	865.95	261,242.02	255,000.00
December.....	423,849.78	2,115.44	6,500.80	.....	.....	74,076.41	\$2,965.90	.....	197,131.27	305,000.00
1913—January.....	422,076.28	1,982.68	6,088.70	.....	35.00	59,987.86	.....	.....	736,936.68	305,000.00
February.....	428,261.99	2,021.93	6,187.59	3.88	.....	61,293.87	.....	.....	296,500.01	315,000.00
March.....	406,223.51	1,955.65	7,533.51	.....	18.50	64,201.83	3,698.80	.....	292,275.44	285,000.00
April.....	424,112.47	2,012.54	9,884.97	344.66	4.25	72,973.31	.....	407.50	540,616.38	315,000.00
May.....	413,317.41	1,980.48	8,240.15	5.05	9.00	71,085.01	.....	647.00	159,390.14	300,000.00
June.....	408,885.06	1,960.15	9,407.68	149.70	10.00	76,697.09	2,931.95	.....	.....	280,000.00
Total.....	4,883,624.13	23,347.12	89,447.95	605.28	191.95	881,728.73	9,646.65	3,046.10	4,286,948.31	3,468,000.00

<sup>1</sup> Includes April, May, and June, 1912.

TABLE 29.—Statement of money-order business, postal savings, and stamp sales fiscal year ended June 30, 1913.

Post office.	Postal receipts.		Postal savings bank transactions.			
	Money-order fees.	Stamp sales.	Balance on hand July 1, 1912.	Deposits.	Withdrawals.	Balance.
Ancon.....	\$3,246.85	{ \$18,644.01 1 295.66 }	\$17,520.00	\$114,789.00	\$88,098.00	\$44,211.00
Balboa.....	1,096.62	4,024.50	27,295.00	115,519.00	97,021.00	45,793.00
Bas Obispo.....	337.54	1,805.00	1,775.00	19,664.00	11,621.00	9,818.00
Corozal.....	1,342.11	3,785.00	29,544.00	200,064.00	154,719.00	74,889.00
Cristobal.....	4,194.63	{ 22,539.00 1 23.18 }	25,230.00	129,842.00	118,310.00	36,762.00
Culebra.....	1,473.01	6,563.00	27,275.00	118,031.00	97,673.00	47,633.00
Empire.....	2,104.71	9,225.00	30,942.00	83,300.00	69,090.00	45,152.00
Gatun.....	2,965.51	12,266.00	33,119.00	180,917.00	152,476.00	61,560.00
Gorgona.....	1,915.89	5,180.00	56,254.00	190,748.00	174,463.00	72,539.00
Las Cascadas.....	840.66	3,971.00	24,430.00	97,947.00	76,773.00	45,604.00
Matachin.....	232.02	1,101.34	2,418.00	11,454.00	6,781.00	7,091.00
Miraflores.....	569.51	2,115.00	16,753.00	66,432.00	48,207.00	34,978.00
Paraiso.....	1,041.95	3,660.00	11,660.00	94,993.00	67,393.00	39,260.00
Pedro Miguel.....	1,538.24	4,045.55	47,977.00	154,230.00	131,458.00	70,749.00
Station A.....	259.53	681.00	2,241.00	8,865.00	8,335.00	2,771.00
Station B.....	188.34	543.75	2,514.00	14,821.00	10,455.00	6,880.00
Monte Lirio.....		195.00				
District quartermaster, Mount Hope.....		255.00				
Total.....	23,347.12	100,917.99	356,947.00	1,601,616.00	1,312,873.00	645,690.00

<sup>1</sup> Second-class postage.

¶ Ancon postal cards redeemed, \$6.39.

TABLE 30.—*Detailed statement of classified expenditures for the fiscal year ending June 30, 1913, and total from beginning of work to date, department of civil administration and Canal Zone government.*

	Zone funds.		Civil administration.		Grand total.	
	Total fiscal year 1913.	Total to June 30, 1913.	Total fiscal year 1913.	Total to June 30, 1913.	Total fiscal year 1913.	Total to June 30, 1913.
Administration.....			\$54,491.57	\$605,828.09	\$54,491.57	\$605,828.09
Supreme and circuit courts.....			32,723.71	364,669.72	32,723.71	364,669.72
Prosecuting attorney.....				39,558.47		39,558.47
District courts.....	\$15,646.15	\$82,988.82			15,646.15	82,988.82
Division of revenues.....	3,463.18	48,174.34	18,444.62	184,559.75	21,907.80	232,734.09
Division of posts.....	107,206.79	444,413.76	79,651.14	732,609.56	186,857.93	1,177,023.32
Purchase of stamps.....	34,363.11	240,930.13			34,363.11	240,930.13
Division of customs.....			9,094.67	75,825.34	9,094.67	75,825.34
Division of lands and buildings.....				102,046.07		102,046.07
Division of estates.....			3,225.02	29,897.65	3,225.02	29,897.65
Police and prisons.....	10,579.05	61,487.67	273,495.12	2,262,693.02	284,074.17	2,324,180.69
Fire protection.....			104,260.57	795,753.33	104,260.57	795,753.33
Public schools.....	88,215.60	440,803.23			88,215.60	440,803.23
Construction of school-houses.....	1,853.71	98,095.97			1,853.71	98,095.97
Repairs of schoolhouses.....	2,267.96	23,137.29			2,267.96	23,137.29
Sanitation.....	18,000.00	53,924.15			18,000.00	53,924.15
Zone charity.....	3,244.80	13,428.70			3,244.80	13,428.70
Maintenance and operation of waterworks and sewers:						
Panama.....			23,997.74	168,748.90	23,997.74	168,748.90
Colon.....			43,359.82	252,935.40	43,359.82	252,935.40
Repairs and maintenance of pavements:						
Panama.....			14,472.96	41,240.52	14,472.96	41,240.52
Colon.....			7,801.78	46,958.57	7,801.78	46,958.57
Miscellaneous Zone public works.....	1,498.96	61,318.12	4,822.84	33,442.96	6,321.80	94,761.08
Treasurer of the Canal Zone.....			8,860.82	47,264.80	8,860.82	47,264.80
Construction of buildings.....	190.31	29,494.00	407.91	514,519.41	598.22	544,013.41
Repairs of buildings.....	621.76	12,367.84	2,278.77	19,757.17	2,900.43	32,125.01
Survey of lands, Canal Zone.....				75,000.00		75,000.00
Miscellaneous contingent.....	586.37	15,844.71			586.37	15,844.71
Construction of roads and trails.....	41,745.29	382,315.26			41,745.29	382,315.26
Maintenance of roads and trails.....	41,313.42	96,133.80			41,313.42	96,133.80
Construction, waterworks and sewers.....	1,531.72	51,622.25			1,531.72	51,622.25
Maintenance, waterworks and sewers.....	2,539.86	10,112.26			2,539.86	10,112.26
Total.....	374,868.04	2,166,592.30	681,389.06	6,393,308.73	1,056,257.00	8,559,901.03



APPENDIX M.

REPORT OF EDWARD J. WILLIAMS, DISBURSING OFFICER.

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ISTHMIAN CANAL COMMISSION,  
DISBURSING DEPARTMENT,  
*Empire, Canal Zone, July 31, 1913.*

SIR: I have the honor to submit the following annual report for the disbursing department covering the fiscal year 1913.

The money situation has been kept well in hand, although there has at times been a tendency toward scarcity of Panama silver. When gold was needed it was shipped from the States to cover the necessity. There appears to be plenty of silver at the present time, and within the next year the question of proper handling of the financial questions incident to the disbursing office, and the maintenance by the United States of the parity between gold and silver in the Republic of Panama, required by treaty, must be taken up.

On May 1, 1913, some changes in the organization were made under your direction, eliminating certain checks on the part of this office, theretofore made part of the passage of payrolls. It resulted in the transfer of several clerks to another department.

Herewith find tabulated statement showing meal tickets and hotel books issued by this office to the various departments for distribution to individual employees, of a grand total value of \$1,305,405; also statement of payments made by me during the fiscal year 1913, amounting to \$29,560,335.93, and showing that during that time, "Miscellaneous collections, United States funds," deposited into the Treasury of the United States amounted to \$3,940,102.82.

Respectfully submitted.

EDWARD J. WILLIAMS,  
*Disbursing Officer.*

Col. GEO. W. GOETHALS, United States Army,  
*Chairman and Chief Engineer, Culebra, Canal Zone.*

*Report of meal tickets and coupon books issued during fiscal year 1913.*

Months.	Hotel books.		Meal tickets.		
	\$4.80.	\$15.	27 cents.	40 cents.	Recruit- ing.
1912.					
July.....	400	2,700	39,800	92,900	1,200
August.....	1,425	5,795	25,400	60,800	1,500
September.....	1,100	3,420	35,000	92,600	2,800
October.....	470	3,280	27,000	62,700	2,000
November.....	1,585	4,910	64,200	105,300	2,800
December.....	475	8,390	30,200	70,100	1,500
1913.					
January.....	445	3,405	23,500	79,500	6,300
February.....	620	2,170	23,900	63,500	6,000
March.....	430	2,944	22,800	51,900	4,500
April.....	300	3,815	36,300	66,400	3,800
May.....	465	9,406	58,000	127,500	1,600
June.....	545	2,295	20,000	47,200	2,600
Total books and tickets.....	8,260	52,530	406,100	920,400	36,600
Value.....	\$39,648	\$787,950	\$109,647	\$368,160	
Total value.....	\$827,598		\$477,807		
Grand total.....	\$1,305,405				

*Payments made by the disbursing department on the Isthmus, fiscal year 1913.*

Months.	Gold rolls.	Silver rolls.	Public bills and reimbursement vouchers.	Total.	Items on rolls each month.		
					Gold.	Silver.	Total.
1912.							
July.....	\$744,782.63	\$871,813.91	\$740,038.23	\$2,356,634.77	5,244	31,609	36,853
August.....	760,903.58	889,093.51	703,250.40	2,353,247.49	5,248	33,203	38,451
September.....	744,070.18	941,103.04	784,859.60	2,470,032.82	5,380	33,909	39,289
October.....	733,884.05	883,382.07	735,670.46	2,352,936.58	5,400	33,202	38,602
November.....	825,851.81	957,471.33	720,174.56	2,503,497.70	5,491	33,609	39,100
December.....	820,691.67	897,873.29	737,953.53	2,456,518.49	5,487	33,636	39,123
1913.							
January.....	727,510.00	893,613.47	787,376.69	2,408,500.16	5,352	32,948	38,300
February.....	812,480.36	978,926.74	776,393.03	2,567,800.13	5,456	34,554	40,010
March.....	729,574.04	924,446.23	732,201.41	2,386,221.68	5,356	35,553	40,909
April.....	775,979.02	1,010,226.94	791,219.04	2,577,425.00	5,456	36,300	41,756
May.....	774,047.47	1,020,385.77	782,903.75	2,577,336.99	5,397	35,873	41,270
June.....	778,859.18	1,027,735.46	743,589.48	2,550,184.12	5,285	36,697	41,982
Total.....	9,228,633.99	11,296,071.76	9,035,630.18	29,560,335.93	64,552	411,093	475,645

In addition to the above, \$3,940,102.82, miscellaneous collections, was deposited with the Treasurer of the United States, Washington, D. C.

## APPENDIX N.

### REPORT OF THE HEAD OF THE DEPARTMENT OF CIVIL ADMINISTRATION FOR THE FISCAL YEAR 1912-13.

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There is submitted below the report of the department of civil administration of the commission for the fiscal year ended June 30, 1913. With the exception of certain reductions made in the personnel, as more fully described in subsequent paragraphs, the organization of the department remains substantially as outlined in the last annual report.

#### LEGISLATION.

Seven acts of Congress and four joint resolutions affecting the Panama Canal and the Canal Zone were enacted during the period covered by this report. The most important of these was the so-called Panama Canal act, approved August 24, 1912, providing for the opening, maintenance, protection, and operation of the Panama Canal and the sanitation and government of the Canal Zone. Section 12 of this act provides that all laws and treaties relating to the extradition of persons accused of crime in force in the United States and all laws relating to the rendition of fugitives from justice as between the several States and Territories of the United States shall extend to and be considered in force in the Canal Zone.

The other acts containing provisions relating to the Canal Zone are the act approved August 13, 1912, entitled "An act to regulate radio communication"; the acts approved August 24, 1912, and June 23, 1913, making appropriations, respectively, for the fiscal years ending June 30, 1913, and June 30, 1914; the act approved August 24, 1912, making appropriations for the support of the Army for the fiscal year ended June 30, 1913, containing a provision respecting the detached duty of commissioned officers in the United States Army; the act approved May 1, 1913, entitled "An act making appropriations for certain expenses incident to the first session of the Sixty-third Congress," which provides, among other things, that collections made by the Isthmian Canal Commission for materials sold or services rendered shall be credited to the appropriations from which payment for such material or services was originally made; and the act approved March 4, 1913, making appropriations to supply deficiencies in appropriations for the fiscal year 1913 and for prior years, providing for payment to the Republic of Panama of \$250,000 as the first annual payment due under the treaty of November 18, 1903.

Three of the joint resolutions, approved July 1, 1912, August 1, 1912, and August 15, 1912, relate to appropriations for the months of July and August, 1912. The joint resolution approved August 24, 1912, amends the provision respecting detached duty of commissioned officers in the United States Army contained in the Army appropriation act approved August 24, 1912.

Five private acts providing for payment to employees or their heirs for injuries sustained by, or deaths of, employees in the service of the Isthmian Canal Commission were enacted during the year.

Seven orders signed by the President, having the effect of law in the Canal Zone, were issued during the year, as follows:

The order of September 12, 1912, consolidating the administrative district of Gorgona with that of Empire and extending the limits of the administrative districts of Empire and Cristobal to include the areas of Gatun Lake lying outside of the east and west lines of the original 10-mile strip of the Canal Zone; order of January 13, 1913, amending sections 10 and 18 of the order of July 21, 1911, providing for the inspection of steam vessels; order of March 19, 1913, providing for the protection of birds and their nests in the Canal Zone; order of March 20, 1913, amending sections 2 and 8 of the order approved February 5, 1912, providing an inexpensive method for the administration of the estates of deceased and insane persons in certain cases, etc.; order of March 20, 1913, relating to foreign corporations doing business in the Canal Zone; order of April 15, 1913, to provide maritime quarantine regulations for the Canal Zone and the harbors of the cities of Panama and Colon, Republic of Panama, which shall take effect upon the official opening of the Panama Canal; and the order signed June 30, 1913, effective July 4, 1913, providing at the option of the defendant for trial by jury in all felony cases. There was also issued under date of December 5, 1912, an order declaring all lands in the Canal Zone to be necessary for canal purposes and authorizing the chairman of the commission to take possession of all such lands on behalf of the United States; and the order of February 18, 1913, excepting from the provisions of the order of December 5, 1912, the area of land in the Canal Zone known as "Las Sabanas."

Four ordinances were enacted by the Isthmian Canal Commission during the year and approved by the Secretary of War, as follows:

Ordinance No. 31, enacted July 18, 1912, and approved August 6, 1912, respecting unlawful riding on labor trains and jumping on or off locomotives, cars, or trains in motion; ordinance No. 32, enacted October 15, 1912, and approved October 26, 1912, amending paragraph (a) of section 7 of the ordinance entitled "Regulations providing for certain taxes and licenses in the Canal Zone, other than for the sale of intoxicating liquors," so as to provide for the exemption from the payment in the Canal Zone of the license tax for the operation of carts when such carts are duly licensed in the Republic of Panama; ordinance No. 33, enacted December 16, 1912, and approved January 13, 1913, amending rules 90 and 91 of the "Rules for the navigation of the Panama Canal and approaches thereto, including all waters under the jurisdiction of the Isthmian Canal Commission," enacted by the Isthmian Canal Commission December 5, 1910, and approved by the Secretary of War December 21, 1910; and ordinance No. 34, enacted December 16, 1912, and approved January 13, 1913, providing for the licensing of navigators of motor boats.

At the meeting of the commission held on April 24, 1913, a resolution was adopted providing that no licenses for the sale of intoxicating liquors in the Canal Zone should be granted for the period commencing July 1, 1913. At the close of the fiscal year there were 35

saloons licensed in the five towns of New Gatun, Gorgona, Matachin, Empire, and Culebra. The early abandonment of the towns of Gorgona and Matachin eliminated those settlements from consideration as points at which licenses might be granted; the proximity of Empire to Camp E. S. Otis made it inadvisable to grant any further licenses at Empire, and the same objection was made with regard to Culebra. As this left only one town, New Gatun, it was decided as a matter of policy to grant no further licenses for the sale of liquors.

#### RELATIONS WITH PANAMA AND FOREIGN REPRESENTATIVES.

Negotiations by correspondence or personal conference between the head of the department of civil administration and the secretary of foreign affairs of the Republic of Panama included, among others, the following subjects in addition to routine matters: The arrest by police officers of Panama of employees of the commission while engaged in the performance of their duties in the cities of Panama and Colon; the enactment of ordinances providing for the reciprocal licensing of carts and wagons used in the transportation of merchandise in the Republic and the Canal Zone; municipal and sanitary improvements in the cities of Panama and Colon; the enactment of new sanitary regulations for the cities of Panama and Colon, and the enforcement of the laws and regulations governing the construction of buildings, sanitation, quarantine, and immigration in those cities; the superior right of the United States under the treaty to the use of rivers and streams in the Republic; the deportation to the Republic of ex-convicts who have served terms of imprisonment in the Canal Zone; the admission of merchandise shipments consigned to the commission, the United States Marine Corps, Tenth Infantry Camp, and United States wireless stations without the intervention of Panaman customs authorities; delay for customs release to shipments consigned to commission and Panama Railroad employees, resulting in accumulated storage charges and congestion of freight; the collection of customs duties on parcel-post packages coming through the post offices of the Canal Zone; the establishment of a uniform schedule of rates to be charged for the transportation of passengers by automobile between points in the Canal Zone and the cities of Panama and Colon; the collection of a tax by Panama upon steamship tickets covering passage to foreign ports; and the tax upon steamship agencies doing business in the Canal Zone and the Republic of Panama.

Correspondence and negotiations of the general character described in the last annual report were also had with the various diplomatic and consular representatives accredited to the Republic of Panama.

The relations of the commission and the Canal Zone Government with the Republic of Panama and with foreign representatives continue satisfactory.

#### EXECUTIVE OFFICE.

The organization of the office of the head of the department of civil administration consists of 1 chief clerk, 1 assistant chief clerk, 16 clerks, 1 storekeeper, 1 translator, and 2 messengers, a reduction of 2 clerks from the number in the service at the close of the previous fiscal year.

## STEAMBOAT-INSPECTION SERVICE.

The organization of the board of local inspectors consists of three members, detailed from other branches of the commission organization, who serve in that capacity without additional compensation. There is also a deputy inspector of hulls and boilers, at \$2,100 per annum, who devotes his entire time to the work of the board. Mr. W. G. Comber, who had been chairman of the board since its creation on November 12, 1909, resigned, effective April 25, 1913, and was succeeded by Lieut. Col. Wm. V. Judson, United States Army.

During the year the board issued 88 licenses to pilots, 41 to masters, 19 of which were issued as joint master-pilot licenses, 22 to mates, and 58 to engineers, a total of 209 licenses.

Eighteen convictions were secured for violations of the rules governing the navigation of the Panama Canal and auxiliary waters, and one conviction for the violation of the Executive order of July 21, 1911, providing for the inspection of steam vessels.

Under the authority of the circular of the chairman of the commission, No. 371, dated January 28, 1911, approved by the Secretary of War, the board made two general inspections of the floating plant of the commission and the Panama Railroad Co., and made such recommendations as would bring the floating plant up to the required standard of efficiency.

Rules 90 and 91, of the rules for the navigation of the Panama Canal, were amended by the ordinance enacted by the Isthmian Canal Commission on December 16, 1912, approved by the Secretary of War January 13, 1913, the effect of the amendment of rule 90 being to limit the application of that section to sail and row boats. Inspections of all other vessels are made under the provisions of the general inspection law (Executive order of July 21, 1911).

Under the provisions of the last named order the board inspected and issued certificates to 94 vessels of all classes. Of these, 18 were over 100 gross tons burden; 3 from 15 to 100 tons, and 73 less than 15 tons. The sum of \$2,738.55 was collected by the collector of revenues in fees for the issuance of the certificates of inspection as compared with \$2,837.15 for the previous fiscal year, or a decrease of \$98.60.

Sections 10 and 18 of the Executive order of July 21, 1911, relating to the inspection of steam vessels, were amended by the order of January 13, 1913, the amendment of section 10 providing for a reduction in the fees covering the inspection of motor boats, and that of section 18 authorizing the board of local inspectors to prescribe the equipment required to be carried by steam vessels. The classification of masters, mates, engineers, etc., fixed in section 1 of the rules and regulations of the board was increased by the addition of Class V under "Mates" and Class VI under "Engineers." A slight modification was also made in the language of section 14 in order that that section might properly refer to the present provisions of law in force.

Under the provisions of the ordinance enacted by the Isthmian Canal Commission on December 16, 1912, and approved by the Secretary of War on January 13, 1913, 162 licenses as navigators of motor boats of less than 15 tons were granted.

One hundred and twenty chauffeurs' licenses were also issued by the board under the provisions of the ordinance of April 15, 1911.

## DIVISION OF POSTS, CUSTOMS, AND REVENUES.

This division includes the postal and customs services, the assessment and collection of taxes and license fees, and the administration of estates of deceased and insane employees of the commission and Panama Railroad Co. The organization of this division consists of 1 collector of revenues (ex officio director of posts), 3 deputy collectors of revenues, 5 inspectors, 18 clerks, 2 messengers, 20 postmasters, 6 assistant postmasters, 30 postal clerks, 18 post office messengers, 1 inspector of post offices, and 5 railway-mail messengers.

## POSTAL SERVICE.

The sale of postage stamps and postal cards, including the revenue derived from the sale of stamp books, amounted to \$100,485.54, and \$318.84 was collected for second-class mail matter. The total income from postal sales was \$100,804.38, as compared with \$87,694.41 for the preceding fiscal year, representing an increase of \$13,109.97, while the increase over the fiscal year ended June 30, 1911, is \$17,910.66.

During the year there were manufactured in the office of the director of posts 66,668 stamp books containing 12 and 24 two-cent stamps and 24 one-cent stamps. These books are manufactured, including cost of printing, at a cost of less than one-third of a cent each and are sold for 1 cent more than the face value of the stamps contained in each. Of the total number made up 46,909 were actually sold to the public, producing a revenue of \$469.09, less \$156.36, the estimated cost of manufacture, or a net revenue of \$312.73.

At Cristobal during the year there were 1,348 dispatches of mail. During the same period 160,742 registered letters and parcels were handled at the post offices of the Zone. Of this number 22,622 were domestic letters, 6,497 domestic parcels, 50,713 foreign letters, 2,805 foreign parcels, 75,425 official letters and parcels registered free, and 2,680 letters and parcels reregistered free. Forty-one per cent of the registered mail matter was official, and therefore franked and carried free. The total number of registered letters and parcels handled represents an increase of 5,109 over the previous fiscal year.

The post offices at Cristobal and Ancon as exchange offices handled 97,693 pieces of registered mail. Of these 4,291 passed through the Ancon post office to and from Panama and Central and South American points and 93,402 through the Cristobal post office to and from points in the United States and foreign countries. Seventy-two thousand nine hundred and thirty-three pouches, sacks, and registered sacks were handled by the railway mail messengers during the year, as compared with 64,099 for the previous year.

Two hundred thirty-eight thousand three hundred and sixteen money orders were issued during the year for a total of \$4,883,624.13, and the fees aggregated \$23,347.12. The number and amount of money orders sold during the past year compared with the preceding fiscal year showed an increase of 10,636 in the number of orders issued and a decrease of \$31,453.16 in the amount of money involved. The amount of the collections from money-order fees amounted to \$457.22 more than for the preceding year. The average amount of

each order issued was \$20.49, as compared with \$21.15 for the fiscal year ended June 30, 1912. There were paid and repaid during the year orders amounting to \$967,223.56, as compared with \$1,354,079.68 for the previous fiscal year. Of the money orders sold during the year orders amounting to \$3,917,899.30 were payable in the United States and foreign countries, and orders amounting to \$965,724.83 were payable in the Canal Zone, as compared with \$3,834,251.55 and \$1,080,825.74, respectively, for the previous fiscal year.

The postal savings system established under the provisions of the Executive order of September 8, 1911, and which became effective on November 8, 1911, shows a substantial increase in deposits and accounts during the year. At the beginning of the fiscal year there were 2,402 open accounts with deposits aggregating \$356,947. During the year there were opened in all post offices 5,699 new accounts, and 4,922 accounts were closed, leaving at the close of the fiscal year 3,179 open accounts. The depositors include citizens or subjects of 45 different nations and dependencies. The total amount of the deposits during this period was \$1,601,616 and the total amount of the withdrawals \$1,312,873, an increase during the year of \$288,743, which, together with the amount on deposit on July 1, 1912, of \$356,947, shows total savings deposits at the close of the fiscal year of \$645,690, or an approximate average of \$203.11 for each of the 3,179 depositors. Practically all of these accounts are in the name of employees of the Isthmian Canal Commission, the Panama Railroad Co., and of the various canal contractors. In addition to the postal savings accounts, the money orders issued and drawn on Canal Zone post offices, payable to the remitter, aggregated on June 30, 1913, \$156,916.28, as compared with \$193,817.40 at the close of the preceding fiscal year. The extent to which the Canal Zone post offices have been used as savings depositories by employees is indicated by the fact that at the close of the year covered by this report the total savings deposits, including the money orders payable to remitter at Canal Zone post offices, aggregated \$802,618, as compared with \$550,764.40 at the close of the preceding fiscal year, or an increase of \$251,815.60.

In order to more fully protect the revenues of the Republic of Panama in the matter of importation of merchandise through the post offices of the Canal Zone, instructions were issued by the director of posts under date of April 2, 1913, to all postmasters to withhold from delivery all mail parcels or parcels of any description until the addressee had either exhibited a receipt showing that the requisite amount of duty had been paid to the Panaman authorities, or presented an authorization for the remission of customs duties. Under this arrangement, as shown by receipts filed by importers, the sum of \$4,284.48 was paid to Panama from April 2 to June 30, 1913, for duties on articles imported through the post offices.

During the month of August, 1912, an official count, for statistical purposes, was made of all mail matter received, dispatched, and handled in transit on the Canal Zone, and during the same period franked matter was weighed. The total number of ordinary letters, paid and official, dispatched during the period was 271,169, of which 79,558, or 30 per cent, were official. Of the 22,905 paid papers and official packages dispatched, 4,263, or 18 per cent, having a total



weight of 10,424 pounds, were official. The total of paid and official registers dispatched was 11,854, of which 6,001, or 54 per cent, weighing 13,609 pounds, were official, and of the 9,739 registers received, 5,570, or 57 per cent, were official. The number of ordinary letters, paid and official, received was 263,615, of which 73,376, or 28 per cent, were carried under frank.

In the office of the director of posts the usual amount of correspondence relating to postal business was handled, which consists largely of correspondence with foreign postal administrations on money order and registry matters, the issuance of duplicate money orders, and the return to countries of origin of unclaimed ordinary mail matter, of which there were 51,873 pieces, 5,973 being domestic letters and parcels and 45,900 foreign letters and parcels. One thousand nine hundred and fifteen misdirected letters were advertised in the Canal Record, of which about 70 per cent were delivered or forwarded to addressees.

No post offices were established or discontinued during the year.

#### CUSTOMS SERVICE.

During the year 281 vessels entered the port of Ancon of a total tonnage of 553,767, and 283 vessels cleared of a total tonnage of 556,306. At Cristobal 280 vessels entered of a tonnage of 849,702, and 283 vessels cleared of a tonnage of 858,703.

The usual customs services were rendered seamen and vessels, and the interests of the Republic of Panama were guarded by customs inspectors on the wharves who prevented smuggling and the entrance of dutiable articles until the proper duties had been paid to the Panaman authorities.

At the port of Ancon there arrived, in transit to the Republic of Panama or other countries, 270 aliens whose entry is prohibited under the exclusion laws. Of this number, 157 were permitted to disembark by authority of the secretary of foreign affairs of the Republic of Panama, and 112 were either transferred to other vessels or returned to the port of embarkation, and 1 escaped.

In the early part of June advice was received that the Treasury Department had approved a plan under which the Canal Zone customs service will examine the boxes, cases, etc., containing the household goods and personal effects of employees of the commission and Panama Railroad Co. and Army officers on duty in the Canal Zone as such, upon their return to the United States, when the shipment is made other than as personal baggage. The boxes, cases, etc., after inspection by a customs officer, are tied and sealed, and a certificate of inspection attached to each piece, thus avoiding the necessity of inspection at the port of entry in the United States. The first shipment under this plan was made on June 14, and between that date and June 30 there were 13 shipments, with a total of 43 pieces, inspected and sealed.

#### LANDS AND BUILDINGS.

The collections for rent of land and buildings for the year amounted to \$11,449.31, of which \$3,748.06 was for land rental, and \$7,701.25 for buildings, including rental charged for quarters occupied by others than commission employees, and for buildings, or parts of

commission buildings, leased under authority of the quartermaster's department.

At the close of the year there were in effect for the rental of land and buildings 319 leases and revocable licenses, of which 312 licenses were for building lots, 1 lease for land, and 6 leases for buildings.

During the year all leases for agricultural land and building lots not covered by revocable licenses were canceled. As compared with the previous fiscal year, there was a decrease in the year ended June 30, 1913, of \$4,792.95 in collections for land rent and an increase of \$210.97 for rental of buildings and rooms.

#### TAXES AND LICENSE FEES.

During the year \$53,855.95 was collected on account of general taxes and licenses, as compared with \$122,674.54 during the year ended June 30, 1912, a decrease of \$68,818.59. This decrease is due to the depopulation of the Canal Zone authorized by the President's order of December 5, 1912. The cancellation of the real estate taxes alone resulted in a loss of revenue of \$24,981.06. Other decreases are especially noted in the slaughterhouse and market and merchandise taxes. There was collected as distillation taxes \$9,130.55 during the period from July 1, 1912, to December 31, 1912. The operation of distilleries and the manufacture of spirituous liquors subsequent to January 1, 1913, was prohibited under the terms of the Executive order of May 21, 1912. During the preceding fiscal year the revenues from this source amounted to \$5,083.71—\$2,353.88 during 1911 and \$3,188.67 during the year 1910.

Thirty-eight licenses for the sale of liquor at retail were issued on July 1, 1912. Three of the licensees failed to renew their licenses at the expiration of the first annual period. The total collections from this source were \$43,800, as compared with \$55,200 for the previous fiscal year. As stated in another paragraph, no licenses for the retail sale of intoxicating liquors have been granted for the fiscal year 1914. Thirty-four thousand two hundred and eight dollars and eighty cents were collected on account of water rents in the Canal Zone, as compared with \$30,012.89 for the previous fiscal year. One thousand one hundred and eighty dollars and thirty-eight cents were collected during the year in license fees from insurance companies doing business in the Canal Zone, as compared with \$1,137.83 for the preceding fiscal year, and the sum of \$100 was collected from two corporations which were authorized to do business in the Canal Zone under the provisions of the Executive order of March 20, 1913, effective June 9, 1913, relating to foreign corporations. Under the provisions of the ordinance providing for the licensing and regulation of motor vehicles in the Canal Zone 124 licenses were issued and \$2,240.50 was collected in license fees. This amount includes payment for licenses and \$1 to cover the metal tag bearing the license number, several of which were issued to replace lost tags. Four hundred and forty-eight bicycle licenses and 121 chauffeurs' licenses were issued, the revenues from those sources being \$488 and \$121, respectively. Under the provisions of section 10 of the Executive order of July 21, 1911, as amended by the order of January 13, 1913, providing for the inspection of steam vessels, \$2,738.55 was collected as inspection fees. There was also collected \$150 covering the issuance of 150 licenses to

navigators of motor boats, under the provisions of the ordinance enacted by the Isthmian Canal Commission on December 16, 1912, and approved by the Secretary of War January 13, 1913.

## ADMINISTRATION OF ESTATES.

The collector of revenues, as ex officio administrator of estates, under the provisions of the Executive order of February 5, 1912, as amended by the order of March 20, 1913, administered upon 470 estates of deceased and insane employees of the commission and the Panama Railroad Co., and there were 78 estates in the course of settlement on June 30, 1913. Prior to March 20, 1913, the jurisdiction in the administration of estates was limited to estates not exceeding in value the sum of \$1,000; such limitation, however, was removed by the order of March 20, 1913.

Of the 470 estates of deceased and insane employees settled during the year, 371 estates were settled with the consular representatives in Panama of the countries of which deceased was a citizen or subject, and 99 estates were settled direct with the heirs, upon satisfactory evidence of heirship being furnished.

The money handled during the year on account of the administrations of estates aggregated \$30,124.24. The amount involved in the settlement of the 470 estates was \$26,523.25, of which \$25,347.28 belonged to the estates of deceased employees and \$1,175.97 to the estates of insane employees.

## SUMMARY OF REVENUES AND COLLECTIONS.

The revenues collected by the division during the year aggregated \$283,846.31 and the total of all moneys handled was \$6,799,210.68, an increase over the previous year in the amount of funds handled of \$963,934.27. That total is made up as follows:

Zone revenues.....	\$283, 846. 31
Money orders issued.....	4, 883, 624. 13
Postal savings certificates sold.....	1, 601, 616. 00
Value of estates.....	30, 124. 24
Total.....	6, 799, 210. 68

## DIVISION OF POLICE AND PRISONS.

The organization of the division of police and prisons remains as described in previous annual reports. Mr. J. P. Fyffe resigned as chief of police, effective September 7, 1912, and was succeeded by Capt. C. W. Barber, United States Army. On June 30, 1913, the division consisted of a chief, an assistant chief, 1 inspector, 3 lieutenants, 8 sergeants, 15 corporals, 122 first-class white police officers, 90 colored policemen, and 5 clerks.

Of this force, 2 corporals, 8 first-class white officers, and 24 colored policemen were assigned to the Panama Railroad Co. and the Canal Zone government and carried on the respective pay rolls of the railroad company and the Zone government from October 1, 1912, to the end of the fiscal year.

A reorganization of the division was effected on September 1, 1912, reducing the authorized strength of the force from 274 to 247. The

reduction was accomplished by abolishing the positions of 1 lieutenant and 26 policemen and changing the classification of 5 corporals to first-class policemen. On October 16 one position of inspector was also abolished when the incumbent was promoted to the position of assistant chief.

During the year 72 white and 33 colored officers separated from the service, and 64 white and 15 colored officers were appointed.

In connection with the reorganization of the force of the division on September 1, 1912, the police districts of Empire and Gorgona were consolidated, resulting in the abolition of Gorgona as a district central station and making it a subpolice district of Empire police district. This change reduced the number of police districts and central stations from four to three, viz, Ancon, Empire, and Cristobal, all other stations being substations and call stations.

Six thousand eight hundred and twenty-seven arrests were made during the year, 6,079 of which were of males and 748 of females, as compared with 6,452 males and 603 females, a total of 7,055 arrests, for the previous year, a decrease of 288. Of the arrests made, 424 were on felony charges, as against 742 for the previous fiscal year. Of the total number of persons arrested, 5,377, or 77 per cent, were convicted.

Seven homicides were committed during the year. Of these, 1 case was the killing by a posse of Panaman police officers near Pedro Miguel on July 4, 1912, of a black Martiniquan, who on May 31, 1912, murdered one of his countrymen. In the remaining 6 cases, 3 of the assailants (2 of whom were unknown) escaped. Of the 3 apprehended, 1 was declared to be insane and committed to the asylum; 1 was found guilty of murder in the first degree and sentenced to be hanged on July 11, 1913, but the death sentence was commuted to life imprisonment on June 30, 1913; and 1 was found guilty of murder in the second degree and sentenced to 10 years at hard labor in the penitentiary.

In addition to the foregoing homicide cases, 3 deaths occurred under circumstances which required police investigation.

One person, a black Martiniquan, committed suicide by hanging sometime between February 16 and 25, 1913, the cause being unknown.

A continuous police patrol of the harbors of Ancon and Cristobal has been maintained, and numerous prosecutions for violations of the navigation laws have resulted. Patrols of the watersheds in the Zone have also been maintained to protect the reservoirs from pollution.

Constant patrols of the area to be flooded by the waters of Gatun Lake were maintained during the year from the stations still within that territory, supplemented by the launch patrol service from Gatun and Gorgona stations. As the removal or destruction of houses within the lake area continued the necessity for additional patrol facilities increased. To meet this condition an additional launch was placed in service to patrol the lake from the Gorgona end. Cooperating with the department of law, the police continue to effect the removal of persons and property of those whose claims of ownership or occupancy have been settled. Such action has already been taken in over 600 cases and reports rendered the office of the head of the department of civil administration and the department of law.

During the year 290 animals were impounded by the Zone police, and a total of \$406.65 was collected for pound fees and maintenance.

On June 30, 1913, there were 133 convicts confined in the penitentiary at Culebra, as compared with 141 on June 30, 1912; 148 on June 30, 1911; 138 on June 30, 1910; 117 on June 30, 1909; and 108 on June 30, 1908. All convicts, except a sufficient detail to perform the necessary work at the penitentiary, have been kept at work on public roads in the Zone, particularly on the construction of the wagon road leading from Empire, Canal Zone, toward Chorrera, Republic of Panama, terminating at the Zone boundary line. The work on this road, which was commenced on March 20, 1911, was completed on January 11, 1913. On January 13, 1913, the stockade at Mandingo, where the convicts were quartered while engaged on this road, was closed, and all convicts, guards, and officers were transferred to the new stockade near Gamboa Bridge and began work on the wagon road leading from Gamboa to connect with the Panama-Empire Road at the east end of Empire Suspension Bridge. The work on this road has progressed satisfactorily during the year.

The value of the work performed by the penitentiary convicts, on the basis of 10 cents gold an hour for each convict, was \$26,561.75, and the cost of guarding, subsisting, and clothing the convicts was \$30,178.23. Included in this amount is \$11,130.84, representing the increased cost of guarding convicts on account of the work performed on public roads.

Four thousand two hundred and ninety-three writs of process in civil and criminal cases were served during the year, and a total of \$7,575.86 was collected and disbursed by the acting marshal (chief of police) and his deputies.

One hundred and ninety-six deaths were investigated by the chief of police or other members of the force, acting as coroner or deputy coroners. Of these, 55 were due to railroad accidents and 29 to accidental drowning.

Police investigation was made of 670 cases of personal injuries, involving 465 commission employees, 73 Panama Railroad Co. employees, and 132 nonemployees, of whom 60 were employees of canal contractors.

A course of target practice with regulation .36-caliber Colt revolvers was held commencing April 26, 1913. With the exception of a few slight modifications, the course of firing was similar to that of the previous year. Three medals of original design were offered as first, second, and third prizes. Satisfactory increase of efficiency and familiarity in handling firearms has resulted from this practice.

#### DIVISION OF FIRE PROTECTION.

The authorized organization of this division consists of 1 chief, 1 assistant chief, 1 clerk, 1 messenger, 6 captains, 6 lieutenants, 37 firemen, 1 engineer of steam fire engine, 1 motor engineer, 1 electrician, and 1 lineman, a total of 57 men. The actual force, however, represents a reduction of 15 men in the number in the service on July 1, 1912, namely, 3 captains, 1 lieutenant, and 11 firemen. All of these reductions became necessary shortly after the beginning of the fiscal year because of a deficiency in the appropriations for the department of civil administration, and in making the reduction

required every effort was made to preserve the highest degree of fire-fighting efficiency possible under the circumstances. With the two automobile fire engines purchased last year, and which are described in the last annual report, it was possible to discontinue the one-man stations at Balboa and Mount Hope, as well as Ancon station No. 2, which was consolidated with station No. 1 near the Tivoli Hotel. The firemen stationed at Toro Point and Porto Bello were withdrawn. Other reductions were at Culebra of 1 captain and 1 fireman; at Gorgona of 1 captain and 1 fireman; at Gatun of 1 fireman, and at Cristobal of 4 firemen. To offset in part this reduced efficiency of the division during the dry season the officers and employees were allowed off only 1 day in every 15 instead of 1 day in every 10 days.

No new fire stations were constructed, nor was any new apparatus purchased during the year. The small building west of the locks at Gatun, occupied as quarters by the paid fireman and an employee of the sanitary department, was turned over to the quartermaster's department on January 16, 1913.

With the approaching abandonment of the town of Gorgona, which is in the area to be flooded by the waters of Gatun Lake, and the consequent removal of commission buildings principally to Corozal and Balboa, all of the fire equipment installed in those buildings was removed and installed in the buildings when reconstructed.

During the year 7,500 feet of new 2½-inch single-jacket fire hose and 3,000 feet of double-jacket hose was received.

The two fire pumps were removed from the tug *Phoenix* at Cristobal and were reinstalled on the tug *Porto Bello*, made necessary because of the sale of the *Phoenix*. The fire pump on the tug *Bolivar* at Balboa was also removed when this tug was withdrawn from service, and the reinstallation of this pump on a claret was approved.

Six fire horses were sold to the quartermaster's department during the year, and one horse died. These horses were disposed of on account of the installation of two new automobile fire engines and hose wagons during the latter part of the previous fiscal year. On June 30, 1913, there remained in service 12 horses.

Two firemen were appointed by the Panama Railroad Co. on January 22, 1913, for special fire protection to bridge No. 57½, which crosses the canal at Paraiso. These firemen were placed under the supervision of this division. One of the men was discharged, after the dry season was over, June 5, 1913, and the other man was retained indefinitely because the bridge is of great importance to the Panama Railroad.

The number of volunteer fire companies on June 30, 1913, was the same as that reported at the close of the last fiscal year, namely, 15, with a total membership of 252.

The existing fire-alarm systems, five in number, were inspected, tested, and kept in working order by the electrician of the division.

At the close of the year there were in use 50,381 feet of 2½-inch rubber-lined hose, 346 nozzles, 18 hose reels, and 23 hose carts. One thousand four hundred and thirty-three fire extinguishers were under the care of the division on June 30, 1913. Thirty thousand two hundred and forty-nine inspections and 759 recharges of chemical extinguishers were made and 379 extinguishers were painted or repaired. The inspection of buildings and fire-fighting apparatus distributed throughout the Zone and in buildings of the United States and the

Panama Railroad Co. in the cities of Panama and Colon and on Naos, Culebra, and Taboga Islands, at the Palo Seco Leper Asylum, and at Porto Bello was maintained.

Two hundred and twenty alarms of fire were responded to during the year, 18 of which were false alarms. Of the 202 actual fires, 1 was in the city of Panama and 7 in the city of Colon; 104 fires were in Government property and 20 in property of the Panama Railroad Co. The value of Government and railroad property involved, including the buildings and their contents, was \$834,077.44, and the total loss is estimated at \$12,173.77 in Government property and \$501.75 in property of the Panama Railroad Co. The average loss in all fires in Government and railroad property was \$102.22.

The largest and most serious fire in the Canal Zone occurred at Toro Point at 2.30 a. m. on February 6, 1913, in 2 two-story four-family quarters of frame construction, causing a loss to the Isthmian Canal Commission of \$11,326.98. The value of the Government property involved was \$19,190.47. The occupants of these buildings sustained a loss of \$3,900, the value of the private property being reported as \$5,000. No paid fireman was stationed at Toro Point, and a detachment of firemen and necessary equipment were sent by launch from Cristobal.

Another serious fire occurred at Balboa on March 16, 1913, in a large pile of lumber, about 500 feet north of the Balboa dock. An oil pipe line under the lumber pile burst shortly after the fire commenced, but the flow of oil was stopped by means of diking. The loss to the Panama Railroad Co. in this fire amounted to \$288.85. There were three other fires in Government property where the losses were from \$100 to \$200.76, and three private fires in which the losses sustained amounted to, respectively, \$350, \$250, and \$150.

The value of the private property involved in the 27 fires reported is estimated at \$207,352.75 and the loss at \$9,845.45.

There were no deaths caused by fires during the year. Five persons received burns more or less serious, and one colored man sustained a broken leg by jumping from the balcony of a burning building at New Gatun.

Satisfactory relations were maintained with the fire departments of the cities of Panama and Colon. During the year extensions of water mains, installations of fire hydrants, and extensions of roads were made, which increased the efficiency of the division.

#### DIVISION OF PUBLIC WORKS.

The work of this division remains as described in the previous reports. The organization of the division consists of 1 superintendent, 1 assistant superintendent, 7 clerks, 1 inspector and messenger, 2 inspectors of plumbing, 1 inspector of meters, 1 market inspector, 3 engineers, 6 foremen, 13 masons, 18 pipe fitters, 20 laborers, and 1 carpenter.

The deficiency in the appropriations for the department of civil administration made it necessary to dispense with the services of two inspectors rated at \$1,980 and \$900 per annum on October 16, 1912, and their duties were performed by other employees of the division.

All of the municipal improvements in the city of Panama that were undertaken under authority of the \$800,000 appropriation have been

completed, and all of the improvements were turned over to this division for maintenance. Work is still in progress on municipal improvements in the city of Colon, but a large part of the work has been completed, and the maintenance of completed improvements has been assumed by this division.

The principal work in connection with the maintenance and repair of the improvements in the cities of Panama and Colon during the year consisted of resurfacing macadam streets and the removal of basket gutters in brick pavements. In connection with the maintenance of the sewer system in the city of Panama, it became necessary during the year to make extensive repairs to the Cocoa Grove sewer outfall along the beach between West Sixteenth and West Twentieth Streets. Repairs were made to about 120 feet of this outfall by constructing solid foundations and substituting 12-inch cast-iron pipe for the vitrified pipe that was originally used. An important part of the maintenance work of the sewer system in the city of Colon consists of the operation of the sump pumping plant. This plant was successfully operated during the entire year, the pumps being operated an average of 364 hours per month, or practically 50 per cent of the time. A storage yard in each of the two cities has been assigned to the division, and during the year sheds for the protection of road rollers and other equipment and material were erected, the work being performed by the maintenance forces of the division.

The construction of a tramway system was in progress in the city of Panama during a great part of the year, and regular inspections of this work were made.

The installation of municipal improvements in the Chorrillo district of the city of Panama was undertaken by contractors during the year, and employees of the division inspected the work.

In the city of Panama there were on June 30, 1913, 2,101 water connections and 22 applications pending, an increase of 116 connections during the year. The installation of all plumbing resulting from these new connections, as well as repairs and extensions of existing plumbing, was inspected by the employees of the division.

The collections of water rents from private consumers for the first three quarters of the year in the city of Panama were \$81,727.75, and the net amount of the bills rendered for the quarter ended June 30, 1913, was \$32,583.75, a total for the year of \$114,311.50. For the first three quarters of the year the amount of water collections in the city of Panama exceeded the quarterly amount necessary to amortize the cost under the contract between the United States Government and the Government of the Republic of Panama, dated September 30, 1910, resulting in a surplus of \$13,219.69, which was applied to the reduction of the capital cost of the waterworks, sewers, and pavements. The average daily consumption of water in the city of Panama was 1,718,000 gallons, and the average daily consumption per capita, based upon the 1911 census of the city, was 48.57 gallons. The average annual charge per connection was \$56.37.

The water mains, hydrants, valves, taps, etc., were kept in order during the year. Meters were tested, repaired, and set as needed, and sewers, manholes, and catch basins were kept clean and in working order.

In the city of Colon on June 30, 1913, there were 866 connections using water and 55 applications for connections pending, making a



total of 921, or an increase during the year of 145 connections. The water collections in Colon from private consumers for the first three quarters of the year were \$52,263.65, and the amount paid by the Panama Railroad Co. and the Isthmian Canal Commission during the same period was \$11,794.50. The net amount of water bills rendered against private consumers for the quarter ended June 30, 1913, was \$19,834.40, and the bills against the Isthmian Canal Commission and the Panama Railroad Co. for the same period amounted to \$4,334.40, making a total for the year of \$88,226.95. For the city of Colon the Republic of Panama was required to pay \$9,675.05 for the first three quarters of the fiscal year in order to liquidate the proportion of the part of the capital cost of the water, sewer, and street systems due, together with interest and expense of operation and maintenance. As the city makes no direct payment for public hydrants, the amount paid by it on account of deficiency collections may be said to cover the water furnished through these hydrants, of which there are 104, and the annual cost for each hydrant and tap would, on that basis, be \$116.29. The average daily consumption of water in Colon was 1,212,894 gallons, and the daily per capita consumption was 68.33 gallons. The average annual charge per private connection was \$89.49. During the year 133 water and sewer connections were made by the division for private property owners in the cities of Panama and Colon at a cost of \$2,610.18, which amount was paid in advance when applications were made for the connections.

In the Canal Zone on June 30, 1913, there were 695 water connections, as compared with 691 connections and 26 applications pending at the close of the fiscal year 1912. All of the plumbing installations resulting from these connections, as well as the repairs and extensions to existing plumbing, were inspected by employees of the division. Zone water bills to a net amount of \$34,135.40 were prepared and forwarded to the collector of revenues for collection, as compared with \$29,120.78 during the previous fiscal year. The average charge per connection was \$49.11.

Eight public markets under the direction of this division were in operation, and a revenue of \$3,805.50 was derived from the rental of space therein, as compared with \$4,183.95 for the preceding fiscal year, a decrease of \$378.45. At the two public slaughterhouses of the Zone, one at Empire and the other at Gorgona, 1,893 cattle, 495 hogs, and 8 goats were slaughtered, a decrease in the total number of animals slaughtered during the preceding fiscal year of 491.

The slaughterhouse at Gorgona was abandoned by this division on June 15, and the market at that point will be abandoned on July 16. The last assignment of space in the market at Gorgona was made for the period beginning June 15, 1913.

The work of construction of roads and trails in the Canal Zone was continued by the construction divisions during the year, and frequent inspections of this work were made by representatives of the division. The Empire-Chorrera Road was completed, and the construction of a new road from Diablo (near Corozal) to Ancon was begun during the year, district prisoners being used on this work. A great deal of repair work was done on the Canal Zone roads during the last year, particularly on the Sabanas Road and the Ancon-Balboa Road, on the Bas Obispo-Gorgona Road and on the Mount

Hope-Gatun Road. The work on the Mount Hope-Gatun Road was begun during the year, and 53 per cent was completed on June 30. Twenty-one and eighteen one-hundredths miles of trails were cleared in the Canal Zone by contract during the year at a total cost of \$1,040, or an average cost of \$40.10 per mile.

#### DIVISION OF SCHOOLS.

The organization of this division consists of 1 superintendent, 1 supervisor of upper grades and high schools, 1 supervisor of primary grades, 2 clerks, 2 supervisors of children, 1 principal of high school, 6 principals of grammar schools, and 72 teachers.

The schools for the year 1912-13 opened on October 1, 1912, with an enrollment in that month of 2,199 children, 1,157 in the white and 1,042 in the colored schools, as compared with 1,174 in the white and 931 in the colored schools during the month of October, 1911. The total enrollment during the year was 1,369 in the white schools and 1,580 in the colored schools.

A new lower grade school for white children was opened at Toro Point on October 14. A new school for first, second, and third grade white children was opened at Corozal on October 28. A new school for third and fourth grade white children was opened at Las Cascadas on May 26, 1913, and the fourth-grade Las Cascadas children attending the Empire school transferred to the new school. Two new rooms were opened at the Cristobal colored school, one on December 9 and one on December 12, making this a six-room school. A new room was opened at the Empire colored school on December 9, 1912, and an additional room was opened at the Gatun colored school on April 1, 1913.

The consolidated high school was transferred from Gatun to Ancon at the opening of school, and branch high schools, freshmen and sophomore years, established at Gatun and Empire. All third and fourth year pupils attended at Ancon, also all first and second year pupils living at Ancon and points south of Culebra. All first and second year pupils living at Gorgona and points south to and including Culebra attended the school at Empire. All first and second year pupils living at Gatun and Cristobal attended the branch high school at Gatun. On April 22, 1913, the second-year pupils attending the high school at Empire were transferred to the Ancon school, as the number in that class had decreased to four. There were seven graduates of the Canal Zone high school.

On June 30, 1913, there were 29 buildings used for school purposes, 14 for white schools and 15 for colored schools. One of these, a school for first and second grade white children, was conducted in a room of the Las Cascadas hotel building, and another for white children of the third and fourth grades was conducted in the church building at that point. A school at Toro Point, for white children in the first three grades, was conducted during the first part of the year in a building used for living apartments and later in a portion of the recreation hall, while the school at Porto Bello for white children from the first to sixth grade was conducted in an apartment of building No. 52, and the church building at Marajal was used for the school there.

No new school buildings were constructed during the year. Old camp buildings were moved and reconstructed for school purposes, one to Corozal as a white school and another to Cristobal as a colored school. An addition of one small room was made to the Ancon white-school building for use as a high-school laboratory.

The white schools at Gorgona and Toro Point and the colored schools at Gorgona and Matachin were closed permanently on June 30, 1913.

A school garden was maintained in connection with the colored school at Empire, from which the estimated income from the sale of the school-garden products was \$348.35 as compared with \$218.64 during the school year 1911-12, \$783 during the school year 1910-11, and \$332.72 during the school year 1909-10. The school garden at the Culebra colored school was abandoned on November 23, 1912.

During the year the sum of \$744 was collected for tuition as compared with \$694 during the previous year.

The system of medical inspection of the pupils inaugurated in the month of January, 1911, has been continued. During the school year 1,044 pupils were examined or treated.

#### CANAL ZONE TREASURY AND ZONE FUNDS.

The office of the treasurer of the Canal Zone consists of a treasurer, an assistant treasurer, and 2 clerks.

At the beginning of the fiscal year there was a balance of \$259,-102.16 on hand in the Zone treasury, and during the year there was collected a total of \$336,603.33, of which the sum of \$124,336.50 was postal receipts.

The expenditures amounted to \$374,868.04. The estimated revenues of the Canal Zone during the current fiscal year, 1914, are \$100,000, exclusive of postal receipts.

The postal revenues during the current fiscal year will, it is estimated, amount approximately to \$84,000, and they will be applied to the maintenance of the postal service.

#### COURTS.

The supreme court held 26 sessions during the year. It affirmed the decision of the circuit court in 2 criminal cases and reversed the decision of that court in 2 criminal cases. Two civil cases were pending in the court at the beginning of the year, 22 were filed, and 18 were disposed of.

In the circuit courts 533 criminal cases were instituted. The defendants were convicted in 369 cases and 93 were acquitted, 67 cases were dismissed, and 4 cases were pending on June 30, 1913. Eight hundred and fifty-eight civil cases were filed; 750 were settled and 108 were pending at the close of the year.

In the district courts 6,748 criminal cases were instituted. The defendants were convicted in 4,913 cases and acquitted in 1,008 cases, 293 cases were dismissed, 531 cases were committed to the circuit courts, and 3 cases were yet pending in the district courts on June 30, 1913. Seven hundred and three civil cases were filed during the year, 668 were disposed of, and 35 cases were pending at the close of the year.

The organization of the judiciary consists of 1 chief justice, 2 associate justices, 3 district judges, 7 clerks, 2 translators, and 2 messengers.

On September 22, 1912, the district court at Gorgona was abolished. On that date under the order of the President of September 12, 1912, effective September 22, 1912, the administrative district of Gorgona was "incorporated into the administrative district of Empire for all judicial, administrative, and political purposes."

#### APPENDICES.

Attention is called to the statements attached as appendices to this report, which indicate in detail the business transacted throughout the department.

GEO. W. GOETHALS,  
*Chairman, in charge of Department of Civil Administration.*

### APPENDICES TO REPORT OF THE HEAD OF THE DEPARTMENT OF CIVIL ADMINISTRATION.

#### APPENDIX I.

- TABLE 1. Sale of postage stamps and collections on account of second-class mail matter, by months, during the fiscal year ended June 30, 1913.
- TABLE 2. Letters and parcels registered, by offices, during the fiscal year ended June 30, 1913.
- TABLE 3. Number of dispatches of mail from the exchange office at Cristobal, and number of pouches, sacks, and registered sacks handled by railway mail messengers during the fiscal year ended June 30, 1913.
- TABLE 4. Destination of dispatches of mail by the exchange office at Cristobal during the fiscal year ended June 30, 1913.
- TABLE 5. Money orders issued, paid and repaid, invalidated, and amount of fees, by months, for the fiscal year ended June 30, 1913.
- TABLE 6. Amount of money orders, by offices, payable to the remitter and drawn on the issuing office, remaining unpaid on June 30, 1913.
- TABLE 7. Customs operations at the port of Ancon during the fiscal year ended June 30, 1913.
- TABLE 8. Customs operations at the port of Cristobal during the fiscal year ended June 30, 1913.
- TABLE 9. Distillation taxes collected during the fiscal year ended June 30, 1913.
- TABLE 10. Collections on account of saloon licenses during fiscal year ended June 30, 1913.
- TABLE 11. Land and building rents collected during the fiscal year ended June 30, 1913.
- TABLE 12. Statement, by months, of estates of deceased and insane employees administered by the administrator of estates during the fiscal year ended June 30, 1913.
- TABLE 13. Number and amount of postal savings accounts opened, including those remaining open on June 30, 1912, at each post office during the fiscal year ended June 30, 1913, together with the number and amount remaining open on June 30, 1913.
- TABLE 14. Number of nationalities of postal savings depositors having open accounts in Canal Zone post offices on June 30, 1913.

#### APPENDIX II.

- TABLE 15. Actual strength of stations and substations on June 30, 1913.
- TABLE 16. Actual strength of division of police and prisons on June 30, 1904-1913.
- TABLE 17. Number of arrests, by fiscal years, made in the Canal Zone since organization of division of police and prisons.
- TABLE 18. Number of arrests, by months, made during the fiscal year ended June 30, 1913.

- TABLE 19. Statement of convictions of persons arrested during the fiscal year ended June 30, 1913.
- TABLE 20. Charges against persons arrested during the fiscal year ended June 30, 1913.
- TABLE 21. Nationality of persons arrested during the fiscal year ended June 30, 1913.
- TABLE 22. Statement of arrests, by stations, during the fiscal year ended June 30, 1913.
- TABLE 23. Occupations of persons arrested during the fiscal year ended June 30, 1913.
- TABLE 24. Crimes committed by prisoners confined in the penitentiary June 30, 1913.
- TABLE 25. Occupations of prisoners confined in the penitentiary June 30, 1913.
- TABLE 26. Nationality of persons confined in the penitentiary June 30, 1913.
- TABLE 27. Ages of prisoners confined in the penitentiary June 30, 1913.
- TABLE 28. Causes of deaths investigated by the coroner during fiscal year ended June 30, 1913.
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## APPENDIX III.

- TABLE 31. Consumption of water and collections made in the city of Panama for the fiscal year ended June 30, 1913.
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- TABLE 38. Revenues collected from July 1, 1912, to June 30, 1913.
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- TABLE 41. Business transacted in the Supreme Court of the Canal Zone.
- TABLE 42. Business transacted in the first circuit court.
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- TABLE 45. Business transacted in the district court of the district of Ancon.
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APPENDIX VII.—*Legislation.*

(For Executive orders see Appendix U.)

## ORDINANCES.

1. Ordinance No. 31, enacted by the Isthmian Canal Commission, July 18, 1912, and approved by the Secretary of War August 6, 1912.
2. Ordinance No. 32, enacted by the Isthmian Canal Commission October 15, 1912, and approved by the Secretary of War October 26, 1912.
3. Ordinance No. 33, enacted by the Isthmian Canal Commission December 16, 1912, and approved by the Secretary of War January 13, 1913.
4. Ordinance No. 34, enacted by the Isthmian Canal Commission December 16, 1912, and approved by the Secretary of War January 13, 1913.

## APPENDIX VIII.

TABLE 48. Licenses issued by the board of local inspectors during the fiscal year ended June 30, 1913.

TABLE 49. Statement of collections for steam vessel inspection for fiscal year ended June 30, 1913.

## APPENDIX IX.

TABLE 50. Detailed statement of fires during the fiscal year ended June 30, 1913.

## APPENDIX X.

TABLE 51. Statement of the treasurer of the Canal Zone, of receipts, disbursements, and balances by appropriations and accounts.

TABLE 52. Statement of the treasurer of the Canal Zone, of receipts and disbursements during the fiscal year ended June 30, 1913.

## APPENDIX 1.—DIVISION OF POSTS, CUSTOMS, AND REVENUES.

TABLE 1.—*Sale of postage stamps and collections on account of second-class mail matter, by months, during the fiscal year ended June 30, 1913.*

Month.	First class.	Second class.	Month.	First class.	Second class.
1912.			1913.		
July.....	\$6,073.00	\$16.19	January.....	\$9,039.55	\$29.78
August.....	7,983.84	15.18	February.....	8,900.00	28.52
September.....	6,894.75	11.74	March.....	9,658.00	35.52
October.....	6,576.00	21.79	April.....	9,223.00	34.40
November.....	8,386.00	24.14	May.....	8,519.40	37.60
December.....	10,661.00	25.21	June.....	8,571.00	38.87
			Total.....	100,485.54	318.84

TABLE 2.—*Letters and parcels registered, by offices, during the fiscal year ended June 30, 1913.*

Name of post office.	Domestic letters registered.	Domestic parcels registered.	Foreign letters registered.	Foreign parcels registered.	Official registered free.	Distribution registered free.	Total.
Ancon.....	4,572	2,320	6,714	1,504	12,701	149	27,960
Balboa.....	1,246	78	1,924	40	2,622	157	6,067
Bas Obispo.....	320	76	351		1,170	173	2,090
Corozal.....	817	357	1,646	46	2,907	41	5,814
Cristobal.....	5,536	1,062	12,945	517	6,108	575	26,773
Cristobal:							
Station A.....	239	46	501	6	891	34	1,717
Station B.....	157	26	301	16	691	141	1,332
Culebra.....	1,264	330	4,024	157	12,492	127	18,394
Empire.....	2,046	456	5,632	141	19,446	110	27,831
Gatun.....	2,127	519	6,949	64	3,916	528	14,103
Gorgona.....	1,259	485	1,531	146	4,549	226	8,196
Las Cascadas.....	979	334	1,022	25	1,811	159	4,330
Matachin.....	108	21	840		482	20	1,471
Miraflores.....	363	20	1,768	10	1,197	89	3,447
Monte Lirio.....	38	7	98	3	69	11	226
Paraiso.....	751	130	2,160	56	1,830	58	4,985
Pedro Miguel.....	800	230	2,307	44	2,543	82	6,006
Total.....	22,622	6,497	50,713	2,805	75,425	2,680	160,742

TABLE 3.—*Number of dispatches of mail from the exchange office at Cristobal, and number of pouches, sacks, and registered sacks, handled by railway mail messengers during the fiscal year ended June 30, 1913.*

Month.	Pouches.	Sacks.	Registered sacks.	Total.	Dispatches.
<b>1912.</b>					
July.....	3, 678	1, 235	373	5, 386	123
August.....	3, 642	1, 114	270	5, 126	115
September.....	3, 690	1, 296	387	5, 373	111
October.....	3, 678	1, 441	497	5, 616	115
November.....	4, 032	1, 241	468	5, 741	107
December.....	4, 547	2, 123	835	7, 505	131
<b>1913.</b>					
January.....	4, 422	1, 738	541	6, 701	112
February.....	4, 062	1, 384	482	5, 928	100
March.....	4, 411	1, 775	605	6, 791	108
April.....	4, 234	1, 579	438	6, 251	113
May.....	4, 217	1, 864	437	6, 518	109
June.....	3, 997	1, 710	390	6, 097	104
Total.....	48, 610	18, 500	5, 823	72, 933	1, 348

TABLE 4.—*Destination of dispatches of mail by the exchange office at Cristobal during the fiscal year ended June 30, 1913.*

Destination.	Number of dispatches.	Destination.	Number of dispatches.
New York, by Panama Railroad and United Fruit steamers.....	94	Dominica.....	13
New Orleans, La. (States' mail).....	61	Grenada.....	26
Key West, Fla.....	1	Montserrat.....	24
Jamaica.....	135	Nevis.....	15
Barbados and distribution.....	26	St. Kitts.....	20
Trinidad and distribution.....	38	St. Lucia.....	22
French lines, Colon-Bordeaux, Colon-St. Nazaire.....	25	St. Vincent.....	26
Martinique.....	25	Colombia.....	61
Gadeloupe.....	4	Port Limon, Costa Rica.....	85
Antigua.....	25	Colon, Republic of Panama.....	596
British Guiana.....	26	Total.....	1, 348

TABLE 5.—*Money orders issued, by months, during fiscal year ended June 30, 1913.*

Month.	Orders issued.	Amount.	Paid and repaid.	Invalidated, paid by warrant.	Fees.
<b>1912.</b>					
July.....	19, 672	\$409, 929. 00	\$109, 449. 65	\$1, 860. 00	\$1, 936. 12
August.....	17, 066	365, 073. 51	87, 887. 66	475. 00	1, 703. 92
September.....	18, 027	369, 093. 11	77, 580. 86	515. 00	1, 765. 75
October.....	18, 656	393, 950. 89	82, 348. 47	52. 00	1, 856. 68
November.....	21, 562	418, 851. 12	76, 954. 80	102. 65	2, 055. 78
December.....	22, 972	423, 549. 78	80, 174. 51	402. 70	2, 115. 44
<b>1913.</b>					
January.....	19, 771	422, 076. 28	65, 824. 56	287. 00	1, 982. 68
February.....	20, 190	428, 261. 99	67, 435. 34	50. 00	2, 021. 93
March.....	20, 014	406, 223. 51	71, 677. 84	76. 00	1, 955. 65
April.....	20, 307	424, 112. 47	82, 617. 19	590. 00	2, 012. 54
May.....	20, 115	413, 317. 41	79, 073. 21	275. 00	1, 980. 48
June.....	19, 964	408, 885. 06	86, 199. 47	65. 00	1, 960. 15
Total.....	238, 316	4, 883, 624. 13	967, 223. 56	4, 750. 35	23, 347. 12

Average value of orders, \$20.49.

*Estimated amount of money orders issued during fiscal year.*

On the United States, certain countries and islands.....	\$3,906,899.10
On offices in the Canal Zone.....	965,724.83
On Costa Rica.....	2,000.00
On Martinique.....	9,000.00
Total amount issued.....	4,883,624.11

TABLE 6.—*Amount of money orders, by offices, payable to the remitter and drawn on the issuing office, remaining unpaid on June 30, 1913.*

Office.	Amount.	Office.	Amount.
Ancon.....	\$6,671.90	Gatun.....	\$33,486.00
Balboa.....	6,985.00	Gorgona.....	7,283.25
Bas Obispo.....	4,452.35	Las Cascadas.....	1,422.50
Corozal.....	22,992.00	Matachin.....	1,751.00
Cristobal.....	7,936.25	Miraflores.....	10,079.68
Cristobal:		Paraiso.....	12,279.50
Station A.....	4,561.25	Pedro Miguel.....	18,089.00
Station B.....	1,763.50		
Culebra.....	11,262.35	Total.....	156,916.28
Empire.....	5,900.75		

TABLE 7.—*Customs operations at the port of Ancon during the fiscal year ended June 30, 1913.*

Nationality.	Class.	Entering.		Clearing.	
		Number.	Tonnage.	Number.	Tonnage.
American.....	Steam.....	91	211,276	94	216,363
British.....	do.....	110	164,845	109	162,297
Peruvian.....	do.....	45	101,405	45	101,405
Chilean.....	do.....	26	51,751	26	51,751
Norwegian.....	do.....	7	21,572	7	21,572
German.....	do.....	1	2,467	1	2,467
Panamanian.....	do.....	1	451	1	451
Total.....		281	553,767	283	566,306

Number of vessels in port from last year.....	7
Tonnage in port from last year.....	10,525
Number of vessels remaining in port.....	14
Tonnage remaining in port.....	16,676
Services to American seamen:	
Seamen shipped.....	675
Seamen discharged.....	781
Seamen deserted.....	77
Seamen deceased.....	2
Movement of passengers and cargo:	
Tons of cargo arriving, in transit.....	240,584
Tons of cargo arriving, local.....	38,953
Number of barrels of oil arriving, local.....	846,000
Tons of cargo departing, in transit.....	353,682
Tons of cargo departing, local.....	2,054
Passengers arriving—	
Cabin.....	4,777
Steerage.....	1,883
Total.....	6,665
Passengers departing—	
Cabin.....	4,972
Steerage.....	1,926
Total.....	6,898
Services to Chinese, Syrians, Turks, Egyptians, etc.:	
Chinese arriving.....	172
Chinese transferred to other ships.....	10
Chinese returned to port of embarkation.....	4
Chinese escaped.....	1
Syrians arriving, in transit.....	61
Turks arriving, in transit.....	28
Egyptians arriving, in transit.....	5
Arabs arriving, in transit.....	4

<sup>1</sup> Pacific Steam Navigation Co. steamship *Arica*, tonnage 1,310, made into a hulk May 20, 1913.



TABLE 8.—*Customs operations at the port of Cristobal during the fiscal year ended June 30, 1913.*

Nationality.	Class.	Entering.		Clearing.	
		Number.	Tonnage.	Number.	Tonnage.
American.....	Steam.....	86	337,008	86	338,837
British.....	do.....	73	210,833	76	217,762
Norwegian.....	do.....	93	193,379	93	193,622
German.....	do.....	17	107,994	17	107,994
Panamanian.....	Schooner.....	1	483	1	483
Total.....		270	849,702	273	858,703

Number of vessels in port from last year.....	7
Tonnage in port from last year.....	21,344
Number of vessels remaining in port.....	4
Tonnage remaining in port.....	12,343
Services to American seamen:	
Seamen shipped.....	119
Seamen discharged.....	59
Seamen deserted.....	27
Seamen deceased.....	3
Movement of passengers and cargo:	
Tons of cargo arriving, in transit.....	136,197
Tons of cargo arriving, local.....	894,027
Tons of cargo departing, in transit.....	138,569
Tons of cargo departing, local.....	24,245
Passengers arriving—	
Cabin.....	16,639
Steerage.....	827
Total.....	17,457
Passengers departing—	
Cabin.....	15,139
Steerage.....	1,209
Total.....	16,348

TABLE 9.—*Distillation taxes collected during the fiscal year ended June 30, 1913.*

Month.	Liters distilled.	Amount.
1912.		
July.....	16,697½	\$1,669.75
August.....	23,504	2,350.40
September.....	14,974	1,497.40
October.....	10,103	1,010.30
November.....	17,132	1,713.20
December.....	8,895	889.50
Total.....	91,305½	9,130.55

NOTE.—By Executive order of May 21, 1912, distillation on the Canal Zone ceased on and after January 1, 1913.

TABLE 10.—*Collections on account of saloon licenses during fiscal year ended June 30, 1913.*

	July 1, 1912.		Jan. 1, 1913.		Total amount.
	Licenses.	Amount.	Licenses.	Amount.	
Cristobal.....	8	\$4,800.00	8	\$4,800.00	\$9,600.00
Empire.....	21	12,600.00	27	16,200.00	28,800.00
Gorgona.....	9	5,400.00			5,400.00
Total.....	38	22,800.00	35	21,000.00	43,800.00

NOTE.—By Executive order of Sept. 12, 1912, effective Sept. 22, 1912, the administrative districts of Empire and Gorgona were consolidated into one district, known as the district of Empire.

TABLE 11.—*Land and building rents collected during the fiscal year ended June 30, 1913.*

Month.	Lands.	Buildings.	Total.	Month.	Lands.	Buildings.	Total.
1912.				1913.			
July.....	\$228.82	\$747.50	\$976.32	January.....	\$543.50	\$617.97	\$1,161.47
August.....	340.40	450.25	790.65	February.....	464.02	619.95	1,083.97
September.....	384.56	900.85	1,285.41	March.....	182.75	576.00	758.75
October.....	343.21	631.50	974.71	April.....	181.54	621.65	803.19
November.....	414.18	628.50	1,042.68	May.....	83.97	622.50	706.47
December.....	406.14	664.53	1,070.67	June.....	174.97	620.05	795.02
				Total.....	3,748.06	7,701.25	11,449.31

TABLE 12.—*Statement, by months, of estates of deceased and insane employees administered by the administrator of estates during the fiscal year ended June 30, 1913.*

Month.	Number received.	Number settled.	Amount of funds collected.
On hand unsettled July 1, 1912.....	98		
1912.			
July.....	21	26	\$644.90
August.....	43	42	2,318.39
September.....	38	12	1,183.22
October.....	33	17	2,253.42
November.....	30	55	2,726.24
December.....	68	106	2,424.26
1913.			
January.....	30	66	3,063.81
February.....	31	20	893.21
March.....	43	18	3,583.60
April.....	35	45	2,726.48
May.....	41	60	6,188.78
June.....	37	3	2,117.94
Total for year.....	548	470	30,124.25

Number of estates remaining unsettled June 30, 1913, 78.

TABLE 13.—*Number and amount of postal-savings accounts opened, including those remaining open on June 30, 1912, at each post office during the fiscal year ended June 30, 1913, together with the number and amount remaining open on June 30, 1913.*

Office.	Total number of accounts opened.	Number remaining open on June 30, 1913.	Value of certificates issued.	Value of certificates paid.	Balance on deposit.
Aneon.....	714	330	\$114,789	\$88,098	\$26,691
Balboa.....	761	288	115,519	97,021	18,498
Bas Obispo.....	82	34	19,664	11,621	8,043
Corozal.....	757	379	200,064	154,719	45,345
Cristobal.....	574	202	129,842	118,310	11,532
Cristobal:					
Station A.....	38	17	8,865	8,335	530
Station B.....	109	44	14,821	10,455	4,366
Culebra.....	751	302	118,031	97,673	20,358
Empire.....	502	253	83,300	69,090	14,210
Gatun.....	786	272	180,917	152,476	28,441
Gorgona.....	770	223	190,748	174,463	16,285
Las Cascaidas.....	491	197	97,947	76,773	21,174
Matachín.....	128	58	11,454	6,781	4,673
Miraflores.....	508	254	66,432	48,207	18,225
Paraiso.....	465	181	94,993	67,393	27,600
Pedro Miguel.....	665	145	154,230	131,458	22,772
Total.....	8,101	3,179	1,601,616	1,312,873	288,743
Balance at close of fiscal year ended June 30, 1912.....					356,947
On deposit June 30, 1913.....					645,690

TABLE 14.—*Number and nationalities of postal-savings depositors having open accounts in Canal Zone post offices on June 30, 1913.*

Nationality.	Ancon.	Balboa.	Bas Obispo.	Corozal.	Cristobal.	Cristobal, station A.	Cristobal, station B.	Culebra.	Empire.	Gatun.	Gorgona.	Las Cascadas.	Matachin.	Miraflores.	Paraiso.	Pedro Miguel.	Total.
Argentina.....											1						1
Australia.....	1	1															2
Austria.....				4	2			2	1	2				1		1	13
British Guiana.....	2	3		9	1			4	9	2				1	1	1	33
British Honduras.....													1				1
Bulgaria.....										1							1
Canada.....	3	1		1	3	1		1		6	5				3	1	25
Chile.....		2															2
China.....															1		1
Colombia.....	2	1	2	1				1						3			10
Costa Rica.....							1			1							2
Cuba.....					1		1							1		1	4
Denmark.....		3													1		13
Dutch Guiana.....	2				4	1				2	2						2
Ecuador.....		2		1											1		4
England.....	3	10	1	7	3	2		1	9	10	8			1	3	1	59
Finland.....		1		1						1	1				1		4
France.....		5		2						1							8
Germany.....	6	1		4	4		1	1	2	6	4			1	8	1	39
Greece.....	1	5		2					2					5			15
Guadeloupe.....	3						4	1						6			14
Holland.....				1													1
India.....		3								1							4
Ireland.....	5			6	5		1			6	2				3	2	30
Italy.....	2	18		6				6	1	1	2			33		1	70
Madagascar.....															1		1
Martinique.....		6					1	6	1			2		3		1	20
New Zealand.....										1							1
Nicaragua.....	1			1	1			3		3					4		12
Norway.....				1									1				1
Panama.....	1	3		1	1		1		4				1	4	1		19
Peru.....		5	1							1				3			10
Porto Rico.....										1							1
Portugal.....		3						1		1				5			10
Russia.....	2	2	2	2				2	1	7	4				1		23
Scotland.....	2			6	1	1				10	1				3	1	25
Spain.....		42		6			2	40	10	2	2	17		54	1	1	177
Sweden.....	3	2	1		5				3	7	5				3	1	30
Switzerland.....				1	3					1							5
Turkey.....								1		1		1		1			4
United States.....	128	90	18	218	147	12	14	104	115	177	144	122	3	15	83	999	1,489
Wales.....										1							1
West Indies.....	163	79	9	99	21		18	128	95	21	39	55	53	117	62	33	992
Total.....	330	288	34	379	202	17	44	302	253	272	223	197	58	254	181	145	3,179

## APPENDIX II.—DIVISION OF POLICE AND PRISONS.

TABLE 15.—*Actual strength of stations and substations on June 30, 1913.*

Station.	Strength.	Station.	Strength.
Headquarters.....	10	Empire—Continued.	
Detective force.....	6	Matachin.....	2
	16	Gorgona.....	9
		Frijoles.....	1
Ancon.....	24		52
Naos Island.....	1		
Balboa.....	13	Cristobal.....	37
Sabanas.....	2	Monte Lirio.....	1
Corozal.....	12	Gatun.....	19
Miraflores.....	8	Mount Hope.....	4
Pedro Miguel.....	10	Toro Point.....	2
	75	Porto Bello.....	2
		Colon Hospital.....	2
Empire.....	19		67
Paraiso.....	4		
Culebra.....	11	Penitentiary.....	24
Las Cascadas.....	3		
Bas Obispo.....	3	Total.....	234

TABLE 16.—*Actual strength of division of police and prisons on June 30, 1904-1913.*

Official title.	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913
Chief of police.....	1	1	1	1	1	1	1	1	1	1
Assistant chief of police.....										
Chief clerk.....		1	1	1	1	1				
Senior clerk.....							1	1	1	1
Clerks.....	1	4	5	6	8	5	4	4	4	4
Copyist.....					1					
Inspectors.....							2	2	2	2
First lieutenant.....	1	1	1	1	1	1				
Second lieutenant.....			1	1	1	1				
Lieutenants.....							4	4	4	3
First-class sergeants.....		4	9	6						
Sergeants.....	6	4	9	6	10	11	8	8	8	8
Corporals.....	2	3	15	13	18	18	20	20	19	15
First-class policemen.....		16	23	59	108	117	112	114	114	111
Policemen.....	75	98	155	90	93	96	111	115	107	89
Engineer, police launch.....						1				
Sailor, police launch.....						1				
Total.....	86	132	220	184	242	253	264	270	261	234

TABLE 17.—*Number of arrests, by fiscal years, made in the Canal Zone since organization of division of police and prisons.*

Period.	Arrests.	Period.	Arrests.
June 2, 1904, to June 30, 1905.....	2, 130	July 1, 1910, to June 30, 1911.....	5, 959
July 1, 1905, to June 30, 1906.....	3, 748	July 1, 1911, to June 30, 1912.....	7, 035
July 1, 1906, to June 30, 1907.....	5, 831	July 1, 1912, to June 30, 1913.....	6, 287
July 1, 1907, to June 30, 1908.....	6, 075	Total.....	50, 307
July 1, 1908, to June 30, 1909.....	6, 275		
July 1, 1909, to June 30, 1910.....	6, 947		

TABLE 18.—*Number of arrests, by months, made during fiscal year ended June 30, 1913.*

Month.	Arrests.	Month.	Arrests.
1912.		1913—Continued.	
July.....	477	February.....	536
August.....	522	March.....	551
September.....	593	April.....	483
October.....	539	May.....	588
November.....	661	June.....	584
December.....	665	Total.....	6, 827
1913.		Arrests with warrant.....	1, 877
January.....	628	Arrests without warrant.....	4, 950

TABLE 19.—*Statement of convictions of persons arrested during fiscal year ended June 30, 1913.*

	Total arrested.	Convictions.		Total arrested.	Convictions.
1912.			1913.		
July.....	477	371	January.....	628	493
August.....	522	403	February.....	536	443
September.....	593	464	March.....	551	446
October.....	539	437	April.....	483	376
November.....	661	514	May.....	588	447
December.....	665	528	June.....	584	455
			Total.....	6, 827	5, 377

TABLE 20.—Charges against persons arrested during the fiscal year ended June 30, 1913.

Offense.	Male.	Female.	Total.	Offense.	Male.	Female.	Total.
Abusive language.....	1		1	Hunting by means of trap gun.....	1		1
Accessory to felony.....	1		1	Incest.....	2		2
Adultery.....	11	11	22	Indecent exposure.....	18	2	20
Aiding and abetting false personation.....	1		1	Insanity.....	15	4	19
Aiding and abetting in misdemeanor.....	1		1	Interfering with an officer.....	8		8
Alighting from moving train.....	175		175	Intoxication.....	404	4	408
Allowing vicious animal at large.....		1	1	Intoxication and disorderly conduct.....	358	14	372
Arson.....	1		1	Keeping a disorderly house.....	2	5	7
Assault.....	36	6	42	Keeping a gambling house.....	2	1	3
Assault and battery.....	499	101	600	Lewd and lascivious cohabitation.....	67	62	129
Assault with deadly weapon.....	51	4	55	Lewdness.....	1	1	2
Assault with intent to commit crime against nature.....	2		2	Libel.....	2		2
Assault with intent to commit great bodily harm.....	3		3	Loitering.....	269	16	285
Assault with intent to commit rape.....	2		2	Maintaining room for gambling purposes.....	2		2
Assault with intent to kill.....	2		2	Maliciously displacing railroad switch.....	1		1
Attempt to commit assault.....	1		1	Malicious injury to railroad property.....	1		1
Attempt to commit grand larceny.....	1		1	Malicious mischief.....	57	5	62
Attempt to commit murder.....	2		2	Manslaughter.....	4		4
Attempt to commit petty larceny.....	4		4	Mayhem.....	1		1
Attempts to commit rape.....	4		4	Mendicancy.....		1	1
Attempt to defraud.....	45		45	Murder.....	3		3
Attempt to rescue prisoner.....	1		1	Nonsupport.....	49		49
Attempted burglary.....	1		1	Obscene and indecent language.....	13	2	15
Attempted embezzlement.....	2		2	Obtaining money by false pretenses.....	5		5
Attempted forgery.....	1		1	Opening letter without authority.....	1		1
Attempted grand larceny.....	1		1	Practicing medicine without license.....	1		1
Battery.....	150	5	155	Peddling around laborers at work.....			
Bigamy.....	1		1	Petty larceny.....	359	17	376
Boarding moving train.....	150	3	153	Posting notices on buildings without authority.....	25		25
Bringing stolen property into the Canal Zone.....	9	2	11	Purchasing clothing from United States soldier.....	1		1
Burglary.....	61	3	64	Prostitution.....		7	7
Circulating obscene literature.....	5		5	Perjury.....	1		1
Carrying concealed weapons.....	56		56	Rape.....	4		4
Causing false arrest.....	1		1	Receiving stolen property.....	2		2
Civil order of arrest.....	15		15	Resisting an officer.....	2		2
Concealing knowledge of a felony.....	1		1	Returning to Canal Zone after being deported therefrom.....	15		15
Conspiracy.....	3		3	Riding on platform of train.....	177		177
Contempt of court.....	40	8	48	Riding on roof of train.....	52		52
Crime against nature.....	3		3	Rioting.....	8		8
Cruelty to animals.....	76	1	77	Robbery.....	3		3
Desertion from merchant ships.....	13		13	Soliciting insurance without a license.....	1		1
Desertion from United States Army.....	3		3	Seduction.....	1		1
Desertion from United States Marine Corps.....	1		1	Straggling from United States Army.....	6		6
Desertion from United States Navy.....	1		1	Straggling from United States Marine Corps.....	29		29
Destroying public property.....	1		1	Straggling from United States Navy.....	6		6
Detained for deportation.....	8	1	9	Threatening to kill.....	3		3
Detained for investigation.....	1		1	Threats.....	6	1	7
Detained for observation.....	2		2	Trespass.....	18		18
Detained as witness.....	15		15	Trespassing on railroad train.....	110	5	115
Disorderly conduct.....	887	226	1,113	Trespassing on watershed.....	15		15
Disturbing the peace.....	440	113	553	Unauthorized riding on labor train.....	11	2	13
Embezzlement.....	67	2	69	Unlawful assembly.....	8		8
Escaping from officer.....	2		2	Unlawfully occupying land after being evicted therefrom.....	2		2
Escaping from jail.....	9		9	Uttering a false and forged instrument.....	3		3
Exhibiting weapon in a threatening manner.....	1		1	Vagrancy.....	205	39	244
Extortion.....	1		1	Violating bicycle regulations.....	22		22
Extradition.....	4		4	Violating building regulations.....	19	3	22
False personation.....	10		10	Violating chauffeurs' ordinance.....	4		4
Fighting.....	46		46	Violating coach tariff regulations.....	30		30
Forgery.....	33		33	Violating impounding ordinance.....	111	4	115
Fraud.....	74		74				
Gambling.....	109		109				
Grand larceny.....	151	9	160				
Having firearms without permit.....	38		38				
Having stolen property in possession.....	1		1				

TABLE 20.—Charges against persons arrested during the fiscal year ended June 30, 1913—Continued.

Offense.	Male.	Female.	Total.	Offense.	Male.	Female.	Total.
Violating license regulations....	44	.....	44	Violating sanitary regulations..	230	60	290
Violating liquor regulations....	39	10	49	Violating terms of suspended sentence.....	1	1	2
Violating lottery laws.....	1	.....	1	Violating speed ordinance for motor vehicles.....	11	.....	11
Violating ordinance for the licensing and regulation of motor vehicles.....	8	.....	8	Violating water regulations.....	8	.....	8
Violating navigation regulations.....	21	.....	21	Total.....	6,249	762	7,011
Violating revenue laws.....	1	.....	1				

TABLE 21.—Nationality of persons arrested during fiscal year ended June 30, 1913.

Nationality.	Number.	Nationality.	Number.
Argentine Republic.....	3	Great Britain—Continued.	
Austria.....	7	British West Indies—Continued.	
Belgium.....	1	Montserrat.....	38
Bolivia.....	1	Nevis Island.....	5
Chile.....	27	New Providence.....	38
China.....	48	St. Kitts.....	26
Colombia.....	293	St. Lucia.....	90
Costa Rica.....	23	St. Vincent.....	46
Cuba.....	13	Trinidad.....	130
Denmark.....	2	Turks Island.....	6
St. Croix.....	1	Watlings Island.....	1
St. Thomas.....	4	Greece.....	100
Ecuador.....	14	Guatemala.....	6
Egypt.....	4	Haiti.....	10
France.....	27	Holland.....	2
French Guiana.....	7	Dutch West Indies.....	1
French West Indies—		Honduras.....	15
Guadeloupe.....	79	Italy.....	112
Martinique.....	304	Japan.....	1
St. Martins.....	5	Liberia.....	2
Germany.....	29	Mexico.....	28
German Southwest Africa.....	1	Nicaragua.....	13
Great Britain:		Norway.....	10
Australia.....	3	Panama.....	583
British Guiana.....	64	Peru.....	89
Canada.....	9	Portugal.....	16
Ceylon.....	1	Russia.....	3
England.....	26	Finland.....	3
India.....	39	Salvador.....	6
Ireland.....	13	Santo Domingo.....	1
Scotland.....	13	Spain.....	451
British West Indies—		Canary Islands.....	1
Antigua.....	112	Sweden.....	8
Barbados.....	1,656	Switzerland.....	2
Bermuda.....	10	Turkey.....	7
Crooked Island.....	1	Syria.....	3
Dominica.....	9	United States.....	596
Fortune Island.....	61	Hawaii.....	2
Grand Cayman.....	1	Porto Rico.....	13
Grenada.....	108	Venezuela.....	11
Inagua.....	1	Total.....	6,827
Jamaica.....	1,328		
Long Island.....	4		

TABLE 22.—Arrests, by stations, during the fiscal year ended June 30, 1913.

	1912						1913						Total.
	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	
Ancon.....	25	33	43	34	68	54	68	81	49	29	67	78	629
Naos Island.....	2		15	3	5	6	2	7	5	2	3		50
Balboa.....	26	41	49	33	55	54	31	27	53	38	39	43	489
Las Sabanas.....		1		3	7		7	3		1	1	2	25
Corozal.....	3	16	16	22	22	20	28	13	30	17	33	32	252
Miraflores.....	18	15	19	25	35	16	15	15	14	30	13	35	250
Pedro Miguel.....	23	31	65	41	28	54	43	60	33	51	60	28	520
Empire.....	78	115	86	101	104	123	89	104	101	73	111	133	1,226
Paraíso.....	10	11	12	15	17	13	28	6	13	12	12	22	171
Culebra.....	23	27	29	29	55	45	42	28	47	36	40	38	439
Las Cascadas.....	9	6	19	18	14	8	11	3	3	6	15	8	120
Bas Obispo.....	11	5	10	4	13	11	2	5	8	2	9	4	84
Matachin.....	27	9	4	4	10	6	8	4	8	3	6		89
Gorgona.....	42	47	49	20	18	64	30	20	30	21	31	19	391
Frijoles.....		2		1			1			3			7
Cristobal.....	73	66	48	55	62	95	74	47	61	66	66	49	765
Monte Lirio.....				3	2	1	2	1		4	1	2	16
Gatun.....	87	74	100	112	100	55	119	94	74	77	57	66	1,015
Mount Hope.....	12	5	13	12	16	28	21	9	7	7	11	21	162
Toro Point.....	5	9	8	2	3	3	2	4	5		3	1	45
Porto Bello.....	3	9	8	2	27	4	5	5	7	2	7	3	82
Total.....	477	522	593	539	661	665	628	536	551	483	588	584	6,827

TABLE 23.—Occupations of persons arrested during the fiscal year ended June 30, 1913.

Occupation.	Number.	Occupation.	Number.
Acrobat.....	1	Fishermen.....	8
Agents.....	8	Flagmen.....	3
Attorneys.....	2	Foremen.....	115
Bakers.....	46	Gardener.....	1
Banker.....	1	Goldsmiths.....	4
Barbers.....	17	Hostlers.....	6
Bartenders.....	4	Inspectors.....	6
Blacksmiths.....	33	Interpreter.....	1
Blacksmith's helper.....	1	Ironworkers.....	48
Boatman.....	1	Janitors.....	29
Boiler makers.....	22	Jewelers.....	4
Boiler maker's helper.....	1	Jockey.....	1
Brakemen.....	145	Journalist.....	1
Butchers.....	25	Laborers.....	3,206
Carpenters.....	155	Laundresses.....	49
Carpenter's helper.....	1	Laundrymen.....	3
Car repairers.....	4	Linemen.....	6
Charcoal burner.....	1	Liveryman.....	1
Chaufeurs.....	17	Machinists.....	79
Checkers.....	5	Machinist's helpers.....	31
Civil engineers.....	7	Managers.....	4
Clerks.....	104	Manufacturers.....	2
Coachmen.....	116	Marines.....	47
Coal passers.....	5	Masons.....	19
Collectors.....	3	Mattress maker.....	1
Concrete finisher.....	1	Merchants.....	90
Conductors.....	18	Messmen.....	8
Contractor.....	1	Messengers.....	26
Cooks.....	48	Midwives.....	3
Cook's helpers.....	3	Miners.....	3
Coppersmith.....	1	Missionary.....	1
Cranemen.....	15	Molders.....	7
Dentist's assistant.....	1	Musician.....	1
Distiller.....	1	No occupation.....	350
Dish washer.....	1	Nurses.....	2
Diver.....	1	Oilers.....	6
Domestics.....	575	Orderlies.....	4
Dredgemen.....	3	Painters.....	26
Dressmakers.....	15	Pantryman.....	1
Drillmen.....	17	Paymaster.....	1
Druggists.....	2	Peddlers.....	46
Electricians.....	3	Pharmacist.....	1
Electrician's helper.....	1	Photographer.....	1
Engineers.....	46	Physicians.....	5
Farmers.....	256	Pilot.....	1
Firemen.....	133	Pipe fitters.....	11

TABLE 23.—*Occupations of persons arrested during the fiscal year ended June 30, 1913—Continued.*

Occupation.	Number.	Occupation.	Number.
Pitmen.....	2	Soldiers.....	86
Plasterers.....	3	Stevadore.....	1
Plumbers.....	6	Stewards.....	13
Policemen.....	11	Storekeepers.....	11
Porters.....	2	Superintendent.....	1
Potter.....	1	Switch tenders.....	75
Powdermen.....	5	Tailors.....	46
Printers.....	2	Teamsters.....	69
Prostitutes.....	7	Telegraph operator.....	1
Quartermasters.....	2	Telephone operators.....	2
Real-estate operators.....	5	Timekeepers.....	9
Restaurant keepers.....	20	Towerman.....	1
Riggers.....	4	Trainmaster.....	1
Riveters.....	15	Trainmen.....	5
Sailors.....	121	Walters.....	43
Salesmen.....	15	Waitresses.....	2
Saloon keepers.....	10	Watchmen.....	27
School-teachers.....	2	Water boys.....	20
Ships' officers.....	17	Winchmen.....	5
Shipwright.....	1	Wreckers.....	2
Shoemakers.....	19		
Signalman.....	1	Total.....	6,827

TABLE 24.—*Crimes committed by prisoners confined in the penitentiary June 30, 1913.*

Crimes.	Number.	Crimes.	Number.
Arson (second degree).....	1	False personation.....	1
Assault with deadly weapon.....	4	Forgery.....	12
Assault with intent to commit crime against nature.....	1	Grand larceny.....	54
Assault with intent to commit rape.....	1	Incest.....	2
Assault with intent to kill.....	1	Larceny.....	1
Attempt at grand larceny.....	1	Manslaughter.....	2
Attempt to commit crime against nature.....	1	Manslaughter (voluntary).....	1
Attempt to commit rape.....	1	Murder:	
Burglary.....	20	First degree.....	2
Burglary:		Second degree.....	6
First degree.....	11	Rape.....	5
Second degree.....	6	Returning to Canal Zone after being deported therefrom.....	10
Crime against nature.....	1	Robbery.....	1
Embezzlement.....	3		
Escaping from penitentiary.....	2	Total.....	151

TABLE 25.—*Occupations of prisoners confined in penitentiary June 30, 1913.*

Occupation.	Number.	Occupation.	Number.
Barber.....	1	No occupation.....	7
Blacksmith.....	1	Painters.....	3
Boilermaker's helpers.....	2	Pipe fitter.....	1
Brakemen.....	3	Pipe fitter's helper.....	1
Carpenters.....	7	Powder men.....	2
Cigar maker.....	1	Real estate operator.....	1
Clerks.....	2	Rivet boy.....	1
Clerk (postal).....	1	Riveter.....	1
Cooks.....	3	Sailors.....	6
Cook's helper.....	1	Salesmen.....	3
Drill man.....	1	Soldiers.....	2
Drill press runner.....	1	Stevadore.....	1
Electrician.....	1	Switchman.....	1
Engineer (cableway).....	1	Teamsters.....	2
Farmers.....	5	Timekeeper.....	1
Firemen.....	6	Water boys.....	2
Fishermen.....	2	Winch man.....	1
Goldsmith.....	1	Wireman.....	1
Laborers.....	54		
Merchant.....	1	Total.....	133
Messenger.....	1		



TABLE 26.—*Nationality of persons confined in the penitentiary June 30, 1913.*

Nationality.	Number.	Nationality.	Number.
China.....	1	Great Britain:	
Colombia.....	8	British West Indies—Continued.	
Cuba.....	2	St. Kitts.....	1
Denmark: Danish West Indies—St.		St. Lucia.....	1
Thomas.....	1	St. Vincent.....	1
Ecuador.....	1	Trinidad.....	6
France:		Greece.....	2
Algeria.....	1	Italy.....	3
French Guiana.....	1	Mexico.....	1
Martinique.....	9	Panama.....	18
Great Britain:		Peru.....	2
British Guiana.....	2	Spain.....	3
British West Indies—		Turkey.....	1
Antigua.....	1	United States.....	14
Barbados.....	27	Porto Rico.....	1
Bermuda.....	2	Total.....	133
Grenada.....	1		
Jamaica.....	21		
New Providence.....	1		

TABLE 27.—*Ages of prisoners confined in penitentiary June 30, 1913.*

Age.	Black.	White.	White American.	Total.
10 to 15 years.....	2			2
15 to 20 years.....	10		1	11
20 to 30 years.....	63	5	5	73
30 to 40 years.....	30	3	3	36
40 to 50 years.....	7	1	1	9
50 to 60 years.....	1	1		2
Total.....	113	10	10	133

Age of youngest prisoner.....	years..	13
Age of oldest prisoner.....	do.....	53
Able to read and write.....		90
Unable to read or write.....		43

TABLE 28.—*Causes of deaths investigated by the coroner during fiscal year ended June 30, 1913.*

Causes of death.	Number.	Causes of death.	Number.
Apoplexy.....	1	Overdose of liquid ammonia.....	1
Asphyxiation.....	4	Poisoning by chloride of mercury.....	1
Blood poisoning.....	1	Railroad accidents.....	55
Burns, accidental.....	6	Suicide.....	1
Drowning.....	1	Traumatism:	
Drowning, accidental.....	29	Accidental.....	82
Dynamite explosion.....	1	By fracture of skull.....	1
Electrocution, accidental.....	3	Total.....	196
Gunshot wound.....	1		
Homicide.....	7		
Pneumonia and traumatism.....	1		

TABLE 29.—*Nationality of persons whose deaths were investigated by the coroner during the fiscal year ended June 30, 1913.*

Nationality.	Number.	Nationality.	Number.
Austria.....	1	British West Indies—Continued.	
China.....	1	New Providence.....	1
Colombia.....	6	St. Kitts.....	2
Denmark.....	2	St. Lucia.....	2
Danish West Indies—		St. Vincent.....	4
St. Croix.....	1	Trinidad.....	5
France.....	1	Greece.....	3
French West Indies—		Honduras.....	1
Guadeloupe.....	2	Italy.....	1
Martinique.....	11	Mexico.....	1
Germany.....	1	Norway.....	2
Great Britain:		Panama.....	9
England.....	1	Peru.....	2
British Guiana.....	2	Portugal.....	1
British West Indies—		Spain.....	13
Antigua.....	4	Turkey.....	1
Barbados.....	36	United States.....	22
Grenada.....	3	Unknown.....	4
Jamaica.....	46		
Montserrat.....	4	Total.....	196

TABLE 30.—*Statement of accidents involving personal injuries investigated during the fiscal year ended June 30, 1913.*

Nationality.	Number.	Nationality.	Number.
Austria.....	1	British West Indies—Continued.	
China.....	1	St. Lucia.....	2
Colombia.....	12	St. Vincent.....	12
Cuba.....	1	Trinidad.....	6
Denmark.....	3	Greece.....	15
France.....	1	Hayti.....	2
French West Indies—		Holland:	
Guadeloupe.....	6	Dutch West Indies.....	2
Martinique.....	31	Honduras.....	2
Germany.....	2	Italy.....	7
Great Britain:		Mexico.....	3
England.....	1	Norway.....	2
Scotland.....	2	Panama.....	27
British Guiana.....	8	Peru.....	10
British West Indies—		Portugal.....	3
Antigua.....	17	Russia.....	1
Barbados.....	157	Finland.....	1
Bermuda.....	1	Spain.....	36
Fortune Island.....	4	Turkey.....	1
Grenada.....	9	United States.....	80
Jamaica.....	160	Unknown.....	2
Montserrat.....	24	Venezuela.....	3
Nevis.....	4		
New Providence.....	1	Total.....	670
St. Kitts.....	7		

Of the above cases, 465 were Isthmian Canal Commission employees, 73 Panama Railroad Co. employees, 59 McClintic-Marshall Construction Co. employees, 1 American Bridge Co. employee, and 72 nonemployees.

## APPENDIX III.—DIVISION OF PUBLIC WORKS.

TABLE 31.—Consumption of water and collections made in the city of Panama for the fiscal year ended June 30, 1913.

Quarter ending—	Paying connections.	Consumption per quarter.			Daily average consumption.
		Private.	Public hydrants and taps.	Total.	
		<i>Gallons.</i>	<i>Gallons.</i>	<i>Gallons.</i>	<i>Gallons.</i>
Sept. 30, 1912.....	1,990	109,915,650	31,380,600	141,296,250	1,535,828
Dec. 31, 1912.....	2,015	111,401,000	40,933,000	152,334,000	1,655,804
Mar. 31, 1913.....	2,034	129,672,750	46,232,250	175,905,000	1,954,500
June 30, 1913.....	2,060	127,631,000	29,904,000	157,535,000	1,731,153
Total for year.....		478,620,400	148,449,850	627,070,250	1,718,000

Quarter ending—	Amount collected from private consumers.	Total revenue as per agreement.	Average consumption per private connection per quarter.	Average private quarterly bill.
			<i>Gallons.</i>	
Sept. 30, 1912.....	\$23,813.35	\$23,813.35	55,233	\$11.96
Dec. 31, 1912.....	29,272.45	29,272.45	55,285	14.52
Mar. 31, 1913.....	28,641.95	28,641.95	63,752	14.08
June 30, 1913.....	32,583.75	32,583.75	61,956	15.81
Total for year.....	114,311.50	114,311.50	236,226	56.37

<sup>1</sup> Net amount of bills for quarter.

TABLE 32.—Consumption of water and collections made in the city of Colon for the fiscal year ended June 30, 1913.

Quarter ending—	Paying connections.	Consumption per quarter.				Total.	Average daily consumption.
		Private.	Panama R. R. reservation.	Isthmian Canal Commission hospital and quarantine station.	Public hydrants and taps.		
		<i>Gallons.</i>	<i>Gallons.</i>	<i>Gallons.</i>	<i>Gallons.</i>	<i>Gallons.</i>	<i>Gallons.</i>
Sept. 30, 1912.....	751	44,793,850	8,020,050	4,410,000	57,462,825	114,686,725	1,246,594
Dec. 31, 1912.....	795	44,668,000	9,304,060	3,793,000	56,752,000	114,517,000	1,244,750
Mar. 31, 1913.....	821	46,073,550	9,813,000	3,971,250	56,614,132	116,471,932	1,294,132
June 30, 1913.....	851	49,397,400	11,044,500	3,401,250	33,187,700	97,030,850	1,066,273
Total for year.....		184,932,800	38,181,550	15,575,500	204,016,657	442,706,507	1,212,894

Quarter ending—	Amount collected from private consumers.	Amount collected from Panama R. R.	Amount collected from Isthmian Canal Commission.	Amount paid or to be paid by Panama Gov. ernment.	Total revenue per quarter.	Average consumption per private connection.	Average private quarterly bill.	Cost per hydrant.
Sept. 30, 1912...	\$16,159.85	\$2,406.60	\$1,323.00	\$3,740.56	\$23,630.01	59,645	\$21.51	\$43.49
Dec. 31, 1912...	18,124.95	2,791.20	1,137.90	3,620.18	25,674.23	56,186	22.79	42.09
Mar. 31, 1913...	17,978.85	2,944.20	1,191.60	2,314.31	24,428.96	56,118	21.89	26.91
June 30, 1913...	19,834.40	3,313.80	1,020.60	.....	24,168.80	58,046	23.30	.....
Total for year....	72,098.05	11,455.80	4,673.10	9,675.05	97,902.00	229,995	89.49	112.49

<sup>1</sup> Net amount of bills per quarter.

## APPENDIX IV.—DIVISION OF SCHOOLS.

TABLE 33.—*Net monthly enrollment*<sup>1</sup> *and average daily attendance.*

	White schools.		Colored schools.	
	Monthly enrollment.	Average daily attendance.	Monthly enrollment.	Average daily attendance.
1912.				
October.....	1,157	1,031.1	1,042	748.5
November.....	1,202	1,029.9	1,130	742.6
December.....	1,241	1,025.0	1,165	780.5
1913.				
January.....	1,301	1,050.3	1,364	786.7
February.....	1,319	1,046.6	1,417	809.6
March.....	1,334	1,034.4	1,470	819.3
April.....	1,350	1,009.6	1,523	797.6
May.....	1,364	998.5	1,568	736.3
June.....	1,369	940.6	1,580	706.6

<sup>1</sup> Enrollments are net; enrollments given in this table in reports of preceding years were gross.TABLE 34.—*Total enrollment for the year, by schools.*

White schools:		White schools—Continued.	
Ancon high.....	39	Grades—Continued.	
Empire high.....	36	Gorgona.....	172
Gatun high.....	23	Gatun.....	180
Grades—		Cristobal.....	278
Ancon.....	304	Toro Point.....	13
Corozal.....	49	Porto Bello.....	24
Pedro Miguel.....	98		
Paraiso.....	38	Total (gross).....	1,702
Culebra.....	79	Total for all colored schools (gross).....	1,835
Empire.....	232		
Las Cascadas.....	85	Total gross enrollment.....	3,537
Bas Obispo.....	32		

TABLE 35.—*Enrollment by grades.*

	White.	Colored.	Total.
Grade I.....	315	577	892
Grade II.....	203	401	604
Grade III.....	191	316	507
Grade IV.....	152	144	296
Grade V.....	146	101	247
Grade VI.....	132	34	166
Grade VII.....	83	7	90
Grade VIII.....	54		54
Grade IX.....	52		52
Grade X.....	25		25
Grade XI.....	6		6
Grade XII.....	10		10
Total.....	1,369	1,580	2,949

TABLE 36.—*Number of teachers employed.*

	White schools.	Colored schools.	Total.
<b>1912.</b>			
October.....	46	29	75
November.....	45	29	74
December.....	47	31	78
<b>1913.</b>			
January.....	47	31	78
February.....	47	31	78
March.....	46	31	77
April.....	46	32	78
May.....	47	32	79
June.....	47	32	79

*Sickness of teachers.*

	Number of days.		
	White.	Colored.	Total.
<b>1912.</b>			
October.....	23.5		23.5
November.....	34.0		34.0
December.....	20.5		20.5
<b>1913.</b>			
January.....	16.5	3.5	20.0
February.....	58.5	3.0	61.5
March.....	24.5	.5	25.0
April.....	76.0		76.0
May.....	32.5	3.0	35.5
June.....	26.0		26.0
Total.....	312.0	10.0	322.0

TABLE 37.—*Value of products raised in school garden.*

	Unit.	Quantity.	Price.	Proceeds.
Papaya.....	Each.....	328	<i>Cents.</i> 25	\$82.00
Banana.....	Bunches.....	90	35	31.50
Tomato.....	Pounds.....	686	10	68.60
Beans.....	do.....	688	15	103.20
Lettuce.....	Bunches.....	225	3	6.75
Turnips.....	do.....	102	5	5.10
Okra.....	Dozen.....	342	10	34.20
Cabbage.....	Pounds.....	340	5	17.00
Total.....				348.35

## APPENDIX V.—CANAL ZONE FUNDS.

TABLE 38.—Revenues collected from July 1, 1912, to June 30, 1913.

On account of—	Administrative districts.				Total.
	Ancon.	Empire.	Gorgona.	Cristobal.	
Animal license.....	\$22. 50	\$231. 30	\$52. 50	\$147. 00	\$453. 30
Aerated waters.....	638. 40	3, 078. 00	148. 40	1, 512. 40	5, 377. 20
Bicycle license.....	141. 75	141. 75	61. 75	141. 75	487. 00
Building rental.....	3, 617. 75	3, 666. 50	417. 00		7, 701. 25
Burial permits.....	595. 05	595. 05	74. 50	595. 05	1, 859. 65
Cabs and coaches.....		202. 00			202. 00
Carts.....	426. 00	1, 069. 50	20. 50	794. 50	2, 310. 50
Circuit court collections.....	3, 110. 35	3, 110. 35	305. 99	3, 110. 33	9, 637. 02
Chauffeur's license.....	39. 34	39. 33	4. 00	39. 33	122. 00
Corporation tax.....	33. 33	33. 34		33. 33	100. 00
District court collections.....	7, 252. 52	11, 138. 37	566. 34	7, 266. 04	26, 223. 27
Dance halls.....		40. 00		20. 00	60. 00
Distilling license.....	3, 331. 70	3, 174. 50	2, 624. 35		9, 130. 55
Escheated estates.....	2. 50	2. 50		2. 50	7. 50
Gathering coconuts.....				140. 75	140. 75
Hucksters.....				49. 60	49. 60
Hunting permits.....	502. 08	502. 09	128. 75	502. 08	1, 635. 00
Insurance tax.....	389. 29	389. 28	12. 50	389. 31	1, 180. 38
Interest.....	10, 862. 57	10, 862. 58	60. 05	10, 862. 57	32, 647. 77
Land rental.....	413. 38	3, 221. 42	27. 25	69. 90	3, 731. 95
Market rental.....	414. 20	3, 057. 10	100. 40	257. 40	3, 829. 10
Motor vehicle license.....	502. 65	502. 67	120. 88	502. 67	1, 628. 87
Merchandise and drugs.....	756. 60	4, 029. 71	178. 90	1, 681. 10	6, 646. 31
Marshal fees.....	324. 05	390. 05	85. 40	634. 28	1, 633. 78
Navigator license.....	50. 00			50. 00	150. 00
Peddling.....	1, 524. 00	4, 227. 50	167. 50	2, 310. 00	8, 229. 00
Physician's license.....	30. 83	30. 84	2. 50	30. 83	95. 00
Public entertainment.....	27. 00	784. 40	2. 50	489. 40	1, 303. 30
Poll tax.....	92. 40	80. 80		129. 20	302. 40
Pound fees.....	83. 12	122. 01	15. 50	109. 94	330. 57
Police fines.....	47. 41	47. 43	1. 75	47. 41	144. 00
Restaurants.....	241. 20	552. 40	29. 80	403. 60	1, 227. 00
Retail liquor license.....		16, 600. 00		4, 800. 00	21, 400. 00
Retail sale of tobacco.....	676. 40	3, 966. 80	205. 40	1, 693. 60	6, 543. 20
Real estate tax.....	3, 147. 70	2, 076. 12	189. 60	1, 801. 98	7, 215. 40
Sale of property.....	177. 13	177. 14		177. 13	531. 40
Sale impounded animals.....		6. 00		11. 00	17. 00
Sale imported meats.....	7. 67	127. 37	13. 13	68. 22	216. 39
School tuition, lost or damaged books.....	287. 65	287. 66	9. 25	287. 66	872. 22
Service district prisoners.....	26. 34	14. 42		7. 00	47. 76
Slaughter tax.....	87. 50	8, 357. 50	75. 50	1, 294. 50	9, 815. 00
Steamboat inspection.....	902. 06	902. 07	32. 36	902. 06	2, 738. 55
Water tax.....	2, 038. 80	17, 960. 95	11. 50	14, 282. 64	34, 293. 89
Total.....	42, 823. 22	106, 048. 80	15, 746. 75	57, 648. 06	212, 266. 83
Sale of postage stamps.....					100, 451. 79
Sale of stamp books.....					466. 20
Sale of mail matter.....					52. 20
Money-order fees.....					23, 347. 12
Exchange Martinique money-order business.....					19. 19
Total.....					336, 603. 33

<sup>1</sup> Consolidated with Empire district Sept. 1, 1912.

TABLE 39.—*Expenditures from July 1, 1912, to June 30, 1913.*

On account of—	Administrative districts.				Total.
	Ancon.	Empire.	Gorgona.	Cristobal.	
PUBLIC IMPROVEMENTS.					
Roads and trails:					
Construction.....	\$5,059.84	\$32,724.47		\$3,960.98	\$41,745.29
Maintenance.....	23,859.78	14,780.05		2,673.59	41,313.42
Market houses:					
Construction.....		98.84			98.84
Maintenance.....	8.67	539.23		19.15	567.05
Operation.....	580.17	765.41	\$62.19	495.17	1,902.94
Slaughterhouses:					
Construction.....	91.47				91.47
Maintenance.....		54.71			54.71
Operation.....	530.41	484.56	62.18	483.09	1,560.24
Waterworks and sewers:					
Construction.....	13.93	1,042.49		475.30	1,531.72
Maintenance.....	2.82	1,811.60		724.44	2,539.86
Sanitation native village, maintenance.....	5,500.00	7,000.00		5,500.00	18,000.00
Street lighting.....	16.73	891.07		286.86	1,194.66
Miscellaneous public works, maintenance.....		281.95		22.35	304.30
PUBLIC SCHOOLS.					
Schoolhouses:					
Construction.....	1,626.01			227.70	1,853.71
Maintenance.....	594.46	529.29		1,144.21	2,267.96
Salaries—superintendent, teachers, clerks.....	21,206.45	21,206.47	1,812.36	21,206.47	65,431.75
Janitor service.....	982.91	2,204.72	18.00	1,359.15	4,564.78
Furniture and equipment.....	466.88	636.17		491.82	1,594.87
Supplies.....	2,268.71	2,037.94		1,863.10	6,169.75
Traveling and miscellaneous expenses.....	3,617.23	3,643.29	1.71	3,192.22	10,454.45
MAINTENANCE ADMINISTRATIVE DISTRICTS.					
Salaries district judges.....	4,387.09	4,387.09	607.08	4,387.09	13,768.35
Supplies and miscellaneous.....	742.53	574.78		560.49	1,877.80
Zone charity cases, maintenance.....	1,090.30	1,080.50		1,074.00	3,244.80
District prisoners, maintenance.....	3,894.98	4,042.76		1,891.31	9,829.05
Total.....	76,542.37	100,817.39	1 2,563.52	52,038.49	231,961.77
CONTINGENT EXPENSES.					
Gratuity penitentiary prisoners.....					750.00
Miscellaneous.....					586.37
POSTAL SERVICE.					
Purchase of stamps.....					34,363.11
Transportation of mails:					
Isthmus.....					13,990.00
Ocean.....					27,859.11
Miscellaneous expenses.....					10,357.68
Transfer to Isthmian Canal Commission as reimbursement in part for salaries paid.....					55,000.00
Total.....					374,868.04

<sup>1</sup> Consolidated with Empire district Sept. 1, 1912.TABLE 40.—*Statement of balances in the Canal Zone treasury on June 30, 1913.*

Public improvements and schools.....	\$216,676.46
Miscellaneous and contingent.....	7,396.87
Postal receipts, 1913.....	13,260.42
Total.....	237,333.75

## APPENDIX VI.—BUSINESS TRANSACTED IN THE COURTS OF THE CANAL ZONE DURING THE FISCAL YEAR ENDED JUNE 30, 1913.

TABLE 41.—*Supreme court.*

	Criminal cases.	Civil cases.		Criminal cases.	Civil cases.
Pending July 1, 1912.....	1	2	Withdrawn.....		
Filed during year.....	4	22	Dismissed.....		3
Affirmed.....	2	12	Habeas corpus proceedings.....		
Reversed.....	2	3	Pending June 30, 1913.....	1	6
Number of sessions of court.....					26
Number of attorneys admitted.....					9
Collections:					
Civil cases.....					\$216.00
Miscellaneous.....					5.00

TABLE 42.—*First circuit court.*

## CRIMINAL CASES.

Months.	Cases filed.	Convicted.	Acquitted.	Dismissed.	Total collections (fines).
1912.					
Cases pending July 1.....	6				
July.....	7	9	3		\$10.00
August.....	17	13	3	1	185.00
September.....	15	7	8		55.00
October.....	16	10	2		13.00
November.....	26	18	2		236.00
December.....	24	17	12	5	60.00
1913.					
January.....	18	6	1		25.00
February.....	10	12	3	2	94.00
March.....	10	14			57.00
April.....	18	13	3	2	49.00
May.....	27	17	1	2	71.00
June.....	20	21	2	3	26.00
Total.....	214	157	40	16	\$81.00

Forfeitures.....	\$300
Cases pending June 30, 1913.....	1

## CIVIL CASES.

Cases pending July 1, 1912.....	1 33
Cases filed.....	1 559
Cases settled.....	1 553
Cases pending June 30, 1913.....	1 39
Costs.....	\$332.00
Proceeds from marriage licenses, recording fees, notarial fees, and miscellaneous fees.....	\$1,245.20

<sup>1</sup> Including probate cases.



TABLE 43.—*Second circuit court.*

## CRIMINAL CASES.

Months.	Cases filed.	Con- victed.	Aequit- ted.	Dis- missed.	Total col- lections (fines).
1912.					
Cases pending July 1.....	11				
July.....	11	8	4	3	\$42.00
August.....	11	7	3	2	
September.....	16	9	4	1	90.00
October.....	12	7	3	1	45.00
November.....	9	10	1	1	49.00
December.....	13	4	1	3	15.00
1913.					
January.....	8	13		1	75.00
February.....	12	7	3	3	125.00
March.....	23	17		1	130.00
April.....	10	14	2		450.00
May.....	16	7	4		85.00
June.....	13	15	3	1	120.00
Total.....	165	118	28	17	1,226.00

Forfeitures.....	\$50
Cases pending June 30, 1913.....	2

## CIVIL CASES.

Cases pending July 1, 1912.....	157
Cases filed.....	191
Cases settled.....	1119
Cases pending June 30, 1913.....	129
Costs.....	\$1,030.63
Proceeds from marriage licenses, recording fees, notarial fees, and miscellaneous fees.....	\$1,337.02

TABLE 44.—*Third circuit court.*

## CRIMINAL CASES.

Months.	Cases filed.	Con- victed.	Acquit- ted.	Dis- missed.	Collections.		
					Fines.	Costs.	Total.
1912.							
Cases pending July 1.....	6						
July.....	20	6	2	14	\$25.00	\$26.00	\$51.00
August.....	10	12	2	3	45.00		45.00
September.....	15	7	1	1	14.00		14.00
October.....	11	7	3	7	103.00		103.00
November.....	11	10		1	250.00		250.00
December.....	8	6	1	1	65.00		65.00
1913.							
January.....	12	7	1	2	28.00	17.00	45.00
February.....	8	4	3	5		24.00	24.00
March.....	13	5	2	1			
April.....	17	7	5	1			
May.....	11	14	1	2 6	33.00	13.00	46.00
June.....	12	9	4	3 2			
Total.....	154	94	25	34	563.00	\$0.00	643.00

<sup>1</sup> Two forfeitures, \$225.<sup>2</sup> One change of venue.<sup>3</sup> One forfeiture of \$100.

Cases pending June 30, 1913.....	1
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## CIVIL CASES.

Cases pending July 1, 1912.....	137
Cases filed.....	181
Cases settled.....	178
Cases pending June 30, 1913.....	140
Costs.....	\$400.00
Proceeds from marriage licenses, recording fees, notarial fees, and miscellaneous fees.....	\$1,274.25

<sup>1</sup> Including probate cases.

TABLE 45.—*District court, district of Ancon.*

## CRIMINAL CASES.

Months.	Cases filed.	Con- victed.	Acquit- ted.	Commit- ted to circuit court.	Dis- missed.	Collections.		
						Fines.	Costs.	Total.
1912.								
Pending July 1.....	1							
July.....	87	62	14	7	3	\$430.00		\$430.00
August.....	132	96	17	18	2	510.50		510.50
September.....	201	165	22	13	2	530.00	\$2.50	532.50
October.....	167	132	15	15	3	528.50	37.60	566.10
November.....	220	147	30	37	8	698.00	1.30	699.30
December.....	196	154	19	13	9	541.50		541.50
1913.								
January.....	188	145	24	12	8	618.00	2.20	620.20
February.....	190	155	14	15	6	669.50	9.20	678.70
March.....	179	137	21	7	9	757.00	2.50	759.50
April.....	158	111	17	26	19	206.00		206.00
May.....	224	175	20	26	2	796.00		796.00
June.....	206	154	23	28	1	593.00	2.50	595.50
Total.....	2,149	1,633	236	217	62	6,878.00	57.80	6,935.80

<sup>1</sup> 1 change of venue, and 3 were cases of defendants held as witnesses.

Forfeitures.....	\$10
Cases pending June 30, 1913.....	1

## CIVIL CASES.

Cases pending July 1, 1912.....	9
Cases filed.....	185
Cases settled.....	174
Cases pending June 30, 1913.....	20
Costs.....	\$202.55
Miscellaneous.....	\$7.07

TABLE 46.—*District court, district of Empire.*<sup>1</sup>

## CRIMINAL CASES.

Months.	Cases filed.	Con- victed.	Acquit- ted.	Commit- ted to circuit court.	Dis- missed.	Collections.		
						Fines.	Costs.	Total.
1912.								
Pending July 1.....	1							
July.....	209	156	33	12	6	\$760.50		\$760.50
August.....	228	171	37	10	8	850.50	\$2.80	853.30
September.....	221	159	37	10	16	844.00		844.00
October.....	201	156	31	13	23	761.50		761.50
November.....	236	187	39	9	2	1,050.50		1,050.50
December.....	290	228	45	12	5	1,737.50		1,737.50
1913.								
January.....	215	161	31	12	7	1,060.50		1,060.50
February.....	166	122	21	22	3	727.50		727.50
March.....	213	151	32	27	3	954.25		954.25
April.....	161	124	24	11	2	562.00		562.00
May.....	234	165	50	18	4	929.00		929.00
June.....	234	174	44	12	4	1,003.50		1,003.50
Total.....	2,609	1,954	424	168	63	11,241.25	2.80	11,244.05

<sup>1</sup> Includes cases handled in the Gorgona district court to Sept. 22, 1912, the administrative district of Gorgona on that date being "incorporated into the administrative district of Empire for all judicial, administrative, and political purposes" under Executive order of the President of Sept. 12, 1912, effective Sept. 22, 1912.

<sup>2</sup> 1 forfeiture.

<sup>3</sup> 2 forfeitures and 1 change of venue.

<sup>4</sup> 2 forfeitures.

Forfeitures.....	\$125
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## CIVIL CASES.

Cases pending July 1, 1912.....	10
Cases filed.....	262
Cases settled.....	268
Cases pending June 30, 1913.....	4
Costs.....	\$328.91
Miscellaneous.....	13.00

TABLE 47.—*District court, district of Cristobal.*

## CRIMINAL CASES.

Months.	Cases filed.	Con- victed.	Ac- quitted.	Com- mit- ted to circuit court.	Dis- missed.	Total collec- tions (fines).
1912.						
Pending July 1.....	2					
July.....	189	123	30	19	14	\$689.00
August.....	156	91	37	12	17	332.00
September.....	178	125	28	7	15	707.00
October.....	188	128	30	17	19	483.50
November.....	187	127	26	14	16	780.00
December.....	180	122	33	6	20	586.00
1913.						
January.....	199	139	28	9	24	756.00
February.....	144	98	26	11	10	443.00
March.....	149	108	23	9	11	568.00
April.....	145	85	26	17	11	329.00
May.....	130	88	31	8	6	396.00
June.....	143	92	30	17	5	396.00
Total.....	1,990	1,326	348	146	168	6,465.50

Forfeitures.....	\$495
Cases pending June 30, 1913.....	2

## CIVIL CASES.

Cases pending July 1, 1912.....	6
Cases filed.....	231
Cases settled.....	226
Cases pending June 30, 1913.....	11
Costs.....	\$305.54

## APPENDIX VII.—LEGISLATION.

## No. 1.

*Ordinance policing on trains.*

Be it ordained by the Isthmian Canal Commission:

SECTION 1. It shall be unlawful for any person not in the employ of the Isthmian Canal Commission or the Panama Rail Road Company to ride on any labor train without written authority of the chairman and chief engineer of the Isthmian Canal Commission or the head of a department or division of the Isthmian Canal Commission or Panama Rail Road Company. Any person thus offending shall be fined not less than five dollars nor more than twenty-five dollars for each offense.

SEC. 2. It shall be unlawful for any persons except members of a train crew, and construction and transportation officials and employees engaged in the performance of their duties, to jump off or on a railroad locomotive, car, or train while same is in motion, or to ride on the roof or platform of a car of such train. Any person thus offending shall be fined not to exceed ten dollars for each offense.

SEC. 3. This ordinance shall take effect thirty days after its approval by the Secretary of War.

Enacted by the Isthmian Canal Commission July 18, 1912.

Approved by the Secretary of War August 6, 1912.

## No. 2.

*Ordinance license tax for the operation of coaches, carts, etc.*

Be it enacted by the Isthmian Canal Commission: That paragraph (a), section 7, of the ordinance entitled "Regulations providing for certain taxes and licenses in the Canal Zone, other than for the sale of intoxicating liquors," enacted by the Isthmian Canal Commission June 9, 1908, and approved by the Secretary of War June 30, 1908, as said paragraph (a) was amended by ordinance enacted by said commission August

25, 1910, and approved by the Acting Secretary of War October 31, 1910, and as said paragraph now reads, be, and the same is hereby, amended so as to read as follows:

Sec. 7. (a) For the operation or employment of public vehicles not drawn or propelled by steam, gasoline, electricity, or other motor power, the following license taxes shall be charged and collected, to wit: For each coach, carriage, or other conveyance employed in the transportation of passengers for hire, one dollar and twenty-five cents (\$1.25) per month; for each cart, dray, wagon, or other conveyance employed in the transportation of freight, merchandise, or other property for hire, or employed by any merchant in the transportation of merchandise, two dollars and fifty cents (\$2.50) per month for each two-wheeled vehicle, and five dollars (\$5) per month for each four-wheeled vehicle: *Provided, however,* That if no license taxes or charges are imposed or collected in the Republic of Panama for the employment therein of vehicles of the character in this paragraph (a) named, or of either class thereof, which are duly licensed in the Canal Zone, to residents thereof, for employment therein, there shall not be imposed or collected in the Canal Zone any license taxes or charges for the employment therein of like vehicles which are duly licensed in the Republic of Panama, to residents thereof, for employment in said Republic.

Enacted by the Isthmian Canal Commission October 15, 1912.

Approved by the Secretary of War October 26, 1912.

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*Ordinance to amend rules 90 and 91 of the "Rules for the navigation of the Panama Canal and approaches thereto, including all waters under the jurisdiction of the Isthmian Canal Commission," enacted by the Isthmian Canal Commission December 5, 1910, and approved by the Secretary of War December 21, 1910.*

Be it ordained by the Isthmian Canal Commission as follows:

SECTION 1. Rule 90 of the "Rules for the navigation of the Panama Canal and approaches thereto, including all waters under the jurisdiction of the Isthmian Canal Commission," enacted by the Isthmian Canal Commission December 5, 1910, and approved by the Secretary of War December 21, 1910, is hereby amended so that the same shall read as follows:

RULE 90. (a) Hereafter it shall be unlawful for any person to navigate upon the waters of the Canal Zone, for the transportation of passengers for hire, any boat propelled by sail or oars until same, upon application of its master or owner, has been inspected by the board of local inspectors and until there has been issued by said board a certificate based upon such inspection setting forth the following matters, viz: A brief description of the boat, including a statement of its tonnage; the fact that such inspection has been made and that the boat is seaworthy and is safe and suitable for the transportation of passengers; the total number of passengers and crew which may be carried thereon; the life-saving and other equipment which shall be carried thereon; and the portions of the waters of the Canal Zone upon which, and the routes over which, the boat may navigate. Such certificate shall be valid for one year next following the date of its issuance unless during that period said board shall determine that the boat certificated becomes unseaworthy or unsafe or unsuitable for the carriage of passengers; in either of which cases said board shall have the power, and it shall become its duty, to revoke such certificate. Said board shall also have the authority to make, during the period covered by any such certificate, any inspection or examination of any such boat to determine any question of its seaworthiness or of its safety and suitability for the transportation of passengers. Said certificate shall be carried on the boat for which same was issued, suitably framed and displayed and protected from the weather, and shall be always open to the inspection of the Canal Zone authorities. After any such boat shall have been inspected and certificated as aforesaid, it shall be unlawful for any person to navigate same upon the waters of the Canal Zone if any of the equipment named in said certificate is not carried thereon or if the number of passengers and crew carried thereon shall exceed the total number named in the certificate or if such navigation is upon portions of the waters of the Canal Zone or over routes not designated in said certificate. The master or owner of any such vessel may, within ten days after said board renders any decision or takes any action upon any question involving the inspection or certification of any such boat or the revocation of any such certificate, appeal to the head of the department of civil administration, who may thereupon modify or set aside the action of said board, and he shall certify his ruling to said board for its observance in each case.

(b) It is hereby made the duty of the collector of revenues to demand and receive from the owner or master of each such vessel the following compensation for such

inspection and certification, in addition to any other fees which may now or hereafter be allowed by law for issuing enrolments and licenses:

For each vessel of less than fifteen (15) gross tons.....	\$5. 00
For each vessel of fifteen (15) gross tons and over and not exceeding one hundred (100) gross tons.....	10. 00
For each and every gross ton in excess of one hundred (100) gross tons.....	. 05

The fees herein provided for shall be for the use and benefit of the Canal Zone government.

SEC. 2. Rule 91 of said "Rules for the navigation of the Panama Canal and approaches thereto, including all waters under the jurisdiction of the Isthmian Canal Commission," is hereby amended to read as follows:

RULE 91. Any boat, vessel, scow, raft, or other craft used or employed in violating any of the provisions of rules 33, 46, 49, 51, 60, and 89 shall be liable for all damages that may be done to the plant of the Isthmian Canal Commission, and said boat, scow, raft, or other craft may be proceeded against summarily by way of libel in the Canal Zone circuit courts.

SEC. 3. This ordinance shall take effect thirty (30) days after its approval by the Secretary of War.

Enacted by the Isthmian Canal Commission December 16, 1912.

Approved by the Secretary of War January 13, 1913.

### *Ordinance providing for the licensing of navigators of motor boats.*

Be it enacted by the Isthmian Canal Commission as follows:

SECTION 1. That for the purpose of this ordinance any boat or vessel operated by means of gas, gasoline, naphtha, or other like fluid, or by electricity, shall be deemed a motor boat.

SEC. 2. That hereafter it shall be unlawful for any person to navigate or operate in the waters of the Canal Zone any motor boat without first having obtained a license to navigate motor boats as in this ordinance provided, such license to be known as a navigator's license for motor boats.

SEC. 3. Any person desiring to navigate motor boats in the waters of the Canal Zone shall first make written application to the board of local inspectors of the Canal Zone, stating his nationality, age, and character of experience in the operation of motor boats and gasoline and electric machinery; and shall also have his application endorsed by two reputable citizens of the Canal Zone or of the cities of Colon or Panama, Republic of Panama, vouching for his sobriety and trustworthiness. The board of local inspectors shall thereupon examine the applicant touching his knowledge of the use of gasoline, gas, naphtha, and other like fluids, and electricity, in the operation of motors and machinery, and of the mechanism and operation of motor boats, as well as upon his knowledge of the English or Spanish language, and upon the laws and regulations of the Canal Zone relating to the navigation of the aforesaid waters and to the operation of motor boats and other vessels upon said waters. In order to determine the skill of any applicant, said board may require him to make a practical demonstration thereof. If the applicant is found to be competent, the board shall determine whether his knowledge, skill, and experience are such as to qualify him for the navigation, in Canal Zone waters, of motor boats of any tonnage, or of those only of less than 15 gross tons each.

SEC. 4. No person shall be granted such license unless he is not less than 18 years of age, is of sober habits, is able to read either the English or Spanish language, and unless he shall prove to the satisfaction of the board of local inspectors that he has the knowledge, skill, and judgment necessary for the safe and skilful operation and navigation of motor boats.

SEC. 5. The board of local inspectors shall meet at Ancon, Cristobal, or at such other points in the Canal Zone as it may designate, at such times as may be convenient to it and to the applicants for such licenses, and shall examine such applicants. The board shall keep a careful record of all such applications, and of its action thereon, together with any papers submitted in connection with such applications and examinations.

SEC. 6. Upon the completion of an examination as herein provided for, the board of local inspectors shall make a report to the head of the department of civil administration showing whether the applicant is competent under the provisions of this ordinance to operate motor boats in the waters of the Canal Zone, and if the board's

report is to the effect that the applicant is thus competent, the head of the department of civil administration shall issue to the applicant a license as follows:

(a) If the report of said board shows the applicant to be competent to navigate in the aforesaid waters motor boats of any tonnage, the license shall be in form substantially as follows:

**THE GOVERNMENT OF THE CANAL ZONE.**

**NAVIGATOR'S LICENSE FOR MOTOR BOATS OF ANY TONNAGE.**

No. \_\_\_\_\_.

Whereas it has been reported to me by the board of local inspectors that \_\_\_\_\_ has given satisfactory evidence that he is a skilful navigator of motor boats of any tonnage, and can be entrusted to perform the duties of navigator of motor boats of any tonnage in the waters of the Canal Zone, he is therefore licensed to act as such navigator until such time as this license may, for cause, be revoked.

Witness my hand this \_\_\_\_\_ day of \_\_\_\_\_, 19\_\_\_\_.

\_\_\_\_\_  
*Head of the Department of Civil Administration*

Countersigned:

\_\_\_\_\_  
*Chairman Board of Local Inspectors.*

(b) If the report of such board shows the applicant to be competent to navigate only motor boats of less than fifteen gross tons each, the license shall be in substantially the same form as the license described in (a), except that it shall only authorize the licensee to navigate in the aforesaid waters motor boats of less than fifteen gross tons each.

SEC. 7. Coincident with the issuance of any navigator's license herein provided for, the collector of revenues, upon the direction of the head of the department of civil administration, shall deliver to the licensee a metal check or badge having stamped thereon the serial number of the licensee's license and the words and letters "Navigator's license, C. Z." It shall be the duty of each person holding such license to wear or carry with him said check or badge when he is operating any motor boat in the waters of the Canal Zone. For such badge and license, each such licensee shall pay to the collector of revenues one dollar (\$1), same to become a part of the revenues of the Canal Zone government. Upon the request of any Canal Zone police officer any such licensee, while in charge of any motor boat in the waters of the Canal Zone, shall exhibit such badge. In addition to wearing such badge, the licensee shall have framed and carried on any motor boat which he may be navigating the license issued to him as aforesaid.

SEC. 8. The said navigator's license shall continue in force until it may be revoked for cause, as herein provided for. It shall be unlawful for any person who does not hold a license for the navigation in Canal Zone waters of any motor boat of any tonnage to navigate in said waters any motor boat of fifteen gross tons or over.

SEC. 9. The head of the department of civil administration is hereby given the right to revoke any license issued under the provisions of this ordinance when it shall appear to him that the holder thereof, because of drunkenness or lack of skill in operating motor boats, should not be further entrusted with the operation of such boats in the waters of the Canal Zone.

SEC. 10. Any person who operates a motor boat in or upon the waters of the Canal Zone without first having obtained a license as herein provided for, or without complying with any other requirement of this ordinance applicable to him, shall be guilty of a misdemeanor, and on conviction thereof shall be punished by a fine not to exceed five hundred dollars (\$500), or by imprisonment in the district jail for not more than six months, or by both such fine and imprisonment, in the discretion of the court.

Enacted by the Isthmian Canal Commission, December 16, 1912.

Approved by the Secretary of War, January 13, 1913.

## APPENDIX VIII.—STEAMBOAT-INSPECTION SERVICE.

TABLE 48.—*Licenses issued by the board of local inspectors during the fiscal year ended June 30, 1913.*

<b>Masters' licenses:</b>		
Masters of steam launches.....	3	
Masters of towboats.....	6	
Masters of self-propelling hopper barges.....	11	
Master of steam vessels, less than 100 tons.....	1	
Masters of ladder dredges.....	13	
Masters of suction dredges.....	2	
Masters of dipper dredges.....	5	
	<hr/>	
	41	
<b>Engineers' licenses:</b>		
Chief and second engineers of self-propelling barges.....	23	
Chief and second engineer of towboats.....	1	
Chief, second, and third engineers of seagoing dredges and engineers of all classes of dredges....	21	
Chief, second, third, and fourth engineers of ships, any tonnage.....	7	
Engineers of launches.....	6	
	<hr/>	
	58	
<b>Mates' licenses:</b>		
Mates of self-propelling hopper barges.....	10	
Mates of dredges, all classes.....	12	
	<hr/>	
	22	
<b>Pilots' licenses:</b>		
Pilots of towboats.....	6	
Pilot of passenger and cargo steamers, less than 500 tons.....	1	
Pilots of passenger and cargo steamers, any tonnage.....	81	
	<hr/>	
	88	
	<hr/>	
	209	

TABLE 49.—*Statement of collections for steam-vessel inspection for fiscal year ended June 30, 1913.*

Month.	Number of inspections.	Amount.
<b>1912.</b>		
July.....	4	\$40.00
August.....	4	89.45
September.....	6	60.00
October.....	2	20.00
November.....	10	260.00
December.....	8	85.15
<b>1913.</b>		
January.....	5	50.00
February.....	5	259.05
March.....	9	763.60
April.....	8	629.10
May.....	6	40.00
June.....	7	442.20
Total.....	74	2,738.55

*Classes and tonnage of vessels inspected.*

	Number.	Tons.
Steam vessels.....	14	42,900.00
Tugs.....	4	705.96
Launches.....	56	411.26
Total.....	74	44,017.22

NOTE.—Under an Executive order approved Jan. 13, 1913, effective 30 days thereafter, the charge for inspection of vessels of less than 15 gross tons was fixed at \$5.

## APPENDIX IX.—DIVISION OF FIRE PROTECTION.

TABLE 50.—Detailed statement of fires during the fiscal year ended June 30, 1913.

Town.	Date.	Description.	Owner.	Total value.	Total loss.	Cause of fire.	How extinguished.
Gorgona.....	July 11	Dwelling.....	Private.	\$7,700.00		Explosion of lamp.	Pails of water.
Ancon.....	July 13	Oil rear camp No. 1.....				Unknown.	Allowed to burn out.
Balboa.....	July 15	False alarm.					Line of hose.
Corozal.....	do.	Dwelling.	Private.	1,250.00	\$350.00	Unknown.	Pails of water.
Gorgona.....	July 23	Blacksmith shop.	Isthmian Canal Commission.	6,200.00		Explosion of oil stove.	Line of hose.
Do.	July 24	do.	do.			Oil catching fire.	Line of hose.
Panama.....	July 28	False alarm.					
Do.	July 29	do.					
Pedro Miguel.....	Aug. 10	Native shack.	Private.	65.00	65.00	Unknown.	Outside of hydrant district.
Toro Point.....	Aug. 12	Breakwater trestle.	Isthmian Canal Commission.	20,000.00		Hot coals.	Pails of water.
Corozal.....	Aug. 19	Hotel.	do.	40,000.00		Overheated range.	Fire extinguishers.
Matachin.....	Sept. 1	Dwelling.	Private.	1,750.00	40.00	Incendiary.	Line of hose.
Cristobal.....	Sept. 6	Hotel.	Isthmian Canal Commission.	32,841.51	6.00	Electric light placed in clothing.	Pails of water and hand grenades.
Do.	Sept. 21	do.	do.	32,841.51	5.00	Lighted cigar.	Pails of water.
New Gatun.....	Sept. 23	Dwelling.	Private.			Stove.	Burning articles thrown out.
Pedro Miguel.....	Sept. 25	Hotel.	Isthmian Canal Commission.			Range.	Fire extinguisher.
Gorgona.....	do.	False alarm.		8,000.00		Defective smokestack.	Pails of water.
Culebra.....	Oct. 4	Repair shop.	Isthmian Canal Commission.	13,000.00		Electric light placed in clothing.	Fire extinguisher.
Balboa.....	do.	Dwelling.	do.				
Colon.....	Oct. 13	False alarm.					Line of hose.
Mount Hope.....	Oct. 21	Tar at dry dock.	Isthmian Canal Commission.	50,000.00		Fire under tar kettle.	Burning material removed.
Gatun.....	Oct. 22	Excelsior and hay.	Private.	950.00		Set fire by children.	Pails of water.
Pedro Miguel.....	Oct. 23	Incline tower.	Panama R. R.	100.00		Electric wires.	
Gorgona.....	Oct. 28	False alarm.					
Culebra.....	Nov. 2	Motor-car house.	Isthmian Canal Commission.	20,303.00	35.00	Explosion of gasoline.	Fire extinguishers.
East Balboa.....	Nov. 3	Hotel.	do.			Range.	Fire extinguisher.
Ancon.....	Nov. 6	Oil house.	do.	550.00		Ignition of gasoline.	Fire extinguishers and sand.
Do.	Nov. 13	False alarm.					
Cristobal.....	Nov. 15	Excelsior.				Sparks from locomotive.	Pails of water.
Empire.....	Nov. 18	Dwelling.	Private.	6,000.00	15.00	Oil stove.	Do.
Toro Point.....	Nov. 25	Sand drying house.	Isthmian Canal Commission.	250.00		Furnace.	Line of hose.
Porto Bello.....	Nov. 29	Scrap lumber.	do.			Unknown.	Do.
Gatun.....	Dec. 1	Yardmaster's office.	do.	235.76	200.76	do.	Line of hose, fire extinguisher.
Corozal.....	Dec. 16	Cement sacks.	Panama R. R.			Sparks from locomotive.	Burning articles removed.
Cristobal.....	Dec. 20	Salvation Army Building.	Isthmian Canal Commission.			Chimney burning out.	Allowed to burn out.
Panama.....	Dec. 23	False alarm.					



Dec. 23	Boxes of rails.....	Isthmian Canal Commission.....	1, 872.00	Sparks from locomotive.....	Fire extinguisher, pails of water.
do.	Repair shop.....	do.	12,000.00	Hot coals.....	Fire extinguishers.
Dec. 31	Hotel.....	do.	150.00	Range.....	Fire extinguisher.
Jan. 2	Native dwelling.....	Private.....	200.00	Unknown.....	Outside of hydrant district.
Jan. 3	Box car.....	Isthmian Canal Commission.....	5,000.00	do.	Pails of water.
Jan. 4	Empty boxes.....	do.	7,000.00	Sparks from locomotive.....	Fire extinguisher.
Jan. 6	Trundle.....	do.	11,000.00	Hot coals.....	Line of hose.
Jan. 16	Shops, pit No. 22.....	do.	700.00	Sparks from crane.....	do.
do.	Coal bins.....	do.		Sparks from locomotive.....	do.
Jan. 18	Chaboost.....	Panama R. R.....		do.	Locomotive standpipe.
Jan. 19	False alarm.....	do.		Ignition of gasoline.....	Fire extinguisher.
Jan. 21	Carpenter shop.....	Isthmian Canal Commission.....	35,329.00	Overheated stovepipe.....	Line of hose, fire extinguisher.
Jan. 24	Hotel.....	do.		Sparks from locomotive.....	Fire extinguisher.
Jan. 25	Cement sacks.....	do.		do.	do.
do.	Telephone alarm.....	Isthmian Canal Commission.....	12,500.00	Unknown.....	Line of hose.
Jan. 30	Machine shops.....	do.	3,000.00	Sand dryer.....	Pails of water.
Feb. 2	Dwelling.....	do.		Burning of waste.....	do.
Feb. 3	Bridge timber.....	Panama R. R.....	600.00	Unknown.....	do.
do.	Dismounted car.....	do.	35,000.00	Sparks from locomotive.....	do.
Feb. 4	Ward 12, hospital.....	Isthmian Canal Commission.....	8.50	Unknown.....	Fire extinguisher.
Feb. 5	Grass and oil.....	do.	6,600.00	Sparks from locomotive.....	Line of hose.
do.	Old ties and barrels.....	do.	66.50	do.	Fire extinguisher.
do.	Grass and oil.....	do.		do.	do.
Feb. 6	False alarm.....	Isthmian Canal Commission.....	19,190.47	Unknown.....	Lines of hose.
do.	Dwellings (2).....	Private.....	5,000.00	do.	Pails of water.
do.	Coal bins.....	Isthmian Canal Commission.....	10,000.00	Sparks from locomotive.....	Line of hose.
Feb. 7	Coal bins (rubbish).....	do.		Employees burning rubbish.....	do.
do.	Waste lumber.....	do.		do.	do.
Feb. 9	Rubbish on car.....	do.	1,000.00	Spontaneous combustion.....	do.
Feb. 10	Coal bins.....	do.	10,800.00	Sparks from locomotive.....	do.
Feb. 12	do.	do.	11,800.00	do.	do.
do.	Dump.....	do.		do.	do.
Feb. 13	Chimney of dwelling.....	Isthmian Canal Commission.....	225.00	Chimney burning out.....	Allowed to burn out.
do.	Box cars, dismantled.....	do.		Unknown.....	Line of hose.
Feb. 14	Grass fire.....	do.		Sparks from locomotive.....	Burning material removed.
do.	Ties and lumber.....	Isthmian Canal Commission.....	500.00	Plumber's furnace.....	Line of hose.
Feb. 15	Box car.....	Panama R. R.....		Chimney burning out.....	Fire extinguisher.
Feb. 17	Hotel.....	Isthmian Canal Commission.....		do.	Allowed to burn out.
do.	do.	do.		do.	Line of hose.
Feb. 21	Grass fire.....	do.		Sparks from locomotive.....	Flooding hold of vessel.
do.	Yacht "Rheclair".....	Private.....	160,000.00	Sparks from locomotive.....	Line of hose.
Feb. 24	Coal bins.....	Isthmian Canal Commission.....	10,600.00	Sparks from locomotive.....	Pails of water.
Feb. 25	Dwelling.....	Private.....	200.00	Exposition of lamp.....	Fire extinguisher.
do.	Trundle and coal pocket, etc.....	Isthmian Canal Commission.....	8,270.00	Hot coals from locomotive.....	do.
Feb. 26	Rubbish.....	do.		Unknown.....	Line of hose.
Feb. 27	Grass fire.....	do.		do.	Stamped out.

TABLE 50.—Detailed statement of fires during the fiscal year ended June 30, 1913—Continued.

Town.	Date.	Description.	Owner.	Total value.	Total loss.	Cause of fire.	How extinguished.
Empire.	Feb. 28	Dwelling.	Private.	\$800.00		Explosion of lamp.	Pails of water.
Ancon.	do.	Grass fire.	do.			Unknown.	Do.
Balboa.	do.	Shipways.	Isthmian Canal Commission.	14,500.00	\$15.00	do.	Line of hose.
Do.	do.	Flat car.	do.	825.00	5.00	do.	Pails of water.
Pedro Miguel.	Mar. 1	Telephone pole.	do.	8.00	8.00	do.	Fire extinguishers.
Empire.	do.	Dump.	do.			Spontaneous combustion.	Line of hose.
Balboa.	do.	Transformer station.	Isthmian Canal Commission.			Sparks from locomotive.	Pails of water.
Pedro Miguel.	Mar. 2	Grass and waste lumber.	do.	16,000.00	1.00	do.	Line of hose.
Culebra.	do.	Hotel.	Isthmian Canal Commission.			Range.	Range closed.
Empire.	Mar. 5	Bridge No. 55.	Panama R. R.			Unknown.	Pails of water.
Pedro Miguel.	do.	Waste ties.	Isthmian Canal Commission.	10.00		Sparks from locomotive.	Line of hose.
Do.	do.	Telephone pole.	do.	10.00		do.	Fire extinguisher.
Cristobal.	Mar. 7	Lumber and rubbish.	do.			do.	Line of hose.
Pedro Miguel.	Mar. 8	Trestle No. 4.	Isthmian Canal Commission.	5,000.00		Hot coals from locomotive.	Do.
Colon.	do.	Dwelling.	Panama R. R.			Chimney burning out.	Allowed to burn out.
Pedro Miguel.	do.	Locker.	Private.	14.30	5.50	Ignition with torch.	Line of hose.
Corozal.	do.	Grass fire.	Isthmian Canal Commission.			Employees burning grass.	Do.
Balboa.	Mar. 11	Lumber.	do.			Sparks from locomotive.	Pails of water.
Corozal.	do.	Box car.	Panama R. R.	100.00		do.	Fire extinguishers.
Culebra.	do.	Rock crusher plant.	Isthmian Canal Commission.	900.00		do.	Line of hose.
Balboa.	do.	Supply house.	Panama R. R.	5,000.00		do.	Do.
Culebra.	do.	Waste lumber.	Isthmian Canal Commission.	1,500.00	10.00	do.	Allowed to burn out.
Empire.	Mar. 12	Grass fire.	Private.			Ignited by child.	Do.
Pedro Miguel.	Mar. 13	Locker.	do.	23.45	1.45	Ignition with torch.	Line of hose.
Colon.	Mar. 14	Ice and electric plant.	do.			Heat from smokesack.	Fire extinguisher.
Gorgona.	do.	Dwelling.	do.		.50	Explosion of lamp.	Pail of water.
Balboa.	Mar. 15	Waste lumber.	Isthmian Canal Commission.	1,200.00		Sparks from locomotive.	Pails of water.
Do.	do.	Rubbish.	do.			do.	Do.
Miraflores.	do.	Box car containing cement sacks.	Panama R. R.			Unknown.	Line of hose.
Balboa.	Mar. 16	Timber and freight cars.	do.	2,183.85	288.85	Sparks from locomotive.	Lines of hose.
Gorgona.	Mar. 17	Rubbish.	do.			Employees burning rubbish.	Line of hose.
Culebra.	Mar. 18	Grass fire.	do.			Sparks from steam shovel.	Stamped out.
Do.	do.	do.	do.			Sparks from locomotive.	Line of hose.
Cristobal.	do.	False alarm.	do.			do.	do.
Balboa.	do.	Hotel.	Isthmian Canal Commission.			Range.	Fire extinguishers.
Ancon.	do.	Grass fire.	do.			Employees burning grass.	Beat out.
Pedro Miguel.	do.	Flat car.	Isthmian Canal Commission.	995.00	141.73	Unknown.	Locomotive standpipe.
Balboa.	Mar. 19	Grass fire.	do.			Employees burning grass.	Beat out.
Pedro Miguel.	do.	do.	Isthmian Canal Commission.	35.00		Sparks from locomotive.	Stamped out.
Empire.	Mar. 20	Trestle.	do.	250.00		Hot coals from locomotive.	Line of hose.

Gatun.	Mar. 21	Hotel.	.....do	26,000.00	Sparks from smokestack	Burning articles removed.
Culebra.	do.	Coal trestle, Lirio.	.....do	20,000.00	Unknown.	Line of hose.
Gorgona.	Mar. 22	Dump.	.....do		Sparks from locomotive.	Do.
Do.	do.	do.	.....do		do.	Do.
Gatun.	do.	Hotel.	Isthmian Canal Commission.	26,000.00	Spontaneous combustion.	Do.
Porto Bello.	Mar. 23	Trestle at quarry.	.....do	500.00	Sparks from locomotive.	Do.
Empire.	Mar. 26	Stock pens and chute.	Panama R. R.	1,085.00	do.	Do.
Balboa.	do.	Rubbish near dwelling.	.....do	5,195.00	do.	Do.
Gorgona.	do.	Dump.	Isthmian Canal Commission.	24.00	Spontaneous combustion.	Do.
Pedro Miguel.	do.	Grass around telephone poles.	.....do		Sparks from locomotive.	Beat out.
Empire.	do.	Waste lumber and material.	.....do	2,500.00	do.	Line of hose.
Ancon.	Mar. 28	Waste lumber.	Panama R. R.		do.	Allowed to burn out.
Gorgona.	do.	Dump.	.....do		do.	Line of hose.
Do.	do.	Grass fire.	.....do		do.	Do.
Culebra.	Mar. 29	do.	Isthmian Canal Commission.	200.00	do.	Beat out.
Gorgona.	do.	Waste lumber at block plant.	.....do	5,000.00	Unknown.	Line of hose.
Ancon.	Mar. 30	do.	Panama R. R.	132.00	Sparks from pile driver.	Do.
Cristobal.	Mar. 31	Baled hay.	.....do		Unknown.	Allowed to burn out.
Colon.	do.	False alarm.	.....do		Sparks from locomotive.	Line of hose.
Gatun.	do.	Grass fire.	.....do		Unknown.	Do.
Gorgona.	do.	Dump.	.....do		Ignition of film.	Lines of hose.
Do.	Apr. 2	Grass fire.	Private.		Spontaneous combustion.	Line of hose.
Colon.	do.	Star Theater.	.....do		Ignited by employees.	Do.
Empire.	do.	Waste material.	.....do		Sparks from locomotive.	Do.
Cristobal.	Apr. 3	Dump.	.....do		do.	Pails of water.
Ancon.	do.	Grass fire.	.....do		Unknown.	Allowed to burn out.
Do.	do.	do.	.....do		Sparks from locomotive.	Cutting trees and back-firing.
Pedro Miguel.	Apr. 4	do.	.....do		Unknown.	Line of hose.
Empire.	Apr. 5	Waste lumber, grass.	.....do		Sparks from locomotive.	Pails of water.
Culebra.	do.	Grass around oil tank.	Isthmian Canal Commission.	15.00	Unknown.	Do.
Ancon.	Apr. 6	Grass fire.	Private.	50.00	Matches.	Do.
Empire.	do.	Oil near fence.	.....do	750.00	Explosion of lamp.	Do.
Do.	Apr. 7	Dwelling.	Isthmian Canal Commission.	900.00	Hot coals from locomotive.	Do.
Miraflores.	do.	Bridge.	.....do		Unknown.	Throwing dirt on fire.
Ancon.	Apr. 8	Logs at rock crusher.	.....do		Employees burning grass.	Pails of water.
Gatun.	do.	Grass fire.	.....do	3,000.00	Overturning of lamp.	Burning articles removed.
Empire.	do.	Hotel.	Private.	50.00	Sparks from locomotive.	Line of hose.
Gatun.	do.	Crescoted ties.	Panama R. R.	200.00	Unknown.	Fire extinguisher.
Do.	Apr. 9	Coal.	Isthmian Canal Commission.	70.00	Sparks from locomotive.	Pails of water and wet sacks.
Empire.	do.	Grass near oil tank.	.....do		Unknown.	Fire extinguisher.
Gatun.	do.	Switch house.	.....do	115.00	Employees burning grass.	Line of hose.
Empire.	Apr. 10	Grass fire.	.....do		Sparks from locomotive.	Fire extinguisher.
Ancon.	Apr. 11	Logs at rock crusher.	Isthmian Canal Commission.		Unknown.	Pails of water.
Do.	do.	Grass fire.	.....do		Sparks from locomotive.	Line of hose.
Gorgona.	do.	Dump near shop.	Isthmian Canal Commission.	1,000.00	do.	Do.
Culebra.	do.	Grass fire.	.....do		do.	Throwing dirt on fire.
Ancon.	Apr. 12	Logs at rock crusher.	Isthmian Canal Commission.		do.	Line of hose.
Do.	Apr. 13	do.	.....do		do.	Line of hose.

TABLE 50.—Detailed statement of fires during the fiscal year ended June 30, 1913—Continued.

Town.	Date.	Description.	Owner.	Total value.	Total loss.	Cause of fire.	How extinguished.
Gatun. Empire. Bar Obispo.	Apr. 14 do. do.	Grass at mixer No. 1. Trestle. Grass fire near dwelling.	Isthmian Canal Commission. do. Private.	\$95.00 250.00 550.00		Unknown. Sparks from locomotive. do.	Stamped out. Line of hose. Do.
Gorgona. Empire.	Apr. 15 do.	Grass beside dwelling. do.	Isthmian Canal Commission. do.	600.00 1,300.00		Unknown. do.	Wet sacks. Do.
Miraflores. Do.	Apr. 16 do.	Trestle. Piling.	do. do.	250.00 1,500.00		Sparks from locomotive. do.	Line of hose. Do.
Culebra. Las Cascadas. Empire.	Apr. 18 Apr. 19 do.	Grass fire. Waste box. Grass fire.	Isthmian Canal Commission. do.	10.00		Unknown. do.	Fire extinguishers. Wet sacks. Line of hose.
Culebra. Do.	do. do.	Palm tree. Grass fire.	Isthmian Canal Commission. do.			Sparks from locomotive. do.	Do.
Miraflores.	do.	Depot.	Panama R. R.	3,600.00		Employees burning rubbish.	Fire extinguisher. Line of hose.
Gorgona. Ancon. Gorgona. Empire.	Apr. 20 Apr. 21 do. do.	Waste material. Grass fire. Dump near shop. Grass fire.	Isthmian Canal Commission. do. Isthmian Canal Commission. do.			Unknown. Sparks from locomotive. Unknown. do.	Do. Stamped out. Line of hose. Wet sacks.
Do.	do.	do.	do.	500.00		Sparks from locomotive.	Line of hose.
Culebra. Miraflores.	do. do.	do. Coal ear.	do. Isthmian Canal Commission.			Unknown.	Wet sacks.
Culebra. Empire.	Apr. 22 Apr. 23	Grass fire. Grass near dwelling.	Isthmian Canal Commission. do.	900.00 2,750.00	\$15.00	Sparks from locomotive. Sparks from locomotive. Employees burning rubbish.	Line of hose. Pails of water. Line of hose.
Do.	do.	Grass at shops.	do.	100.00		Sparks from locomotive.	Wet sacks and brooms.
Culebra. Gorgona. Do.	do. do. do.	Grass fire. Dwelling.	do. Private.			do.	Line of hose. Do.
Ancon. Cristobal.	Apr. 25 Apr. 26	Waste lumber. False alarm.	Isthmian Canal Commission. do.	1,700.00		Employees burning grass. Sparks from stove.	Fire extinguisher. Line of hose.
Gorgona.	Apr. 30	Dwelling.	Isthmian Canal Commission. Private.	250.00		Matches, ignited by child.	Fire extinguisher.
Culebra. Empire. New Gatun.	do. do. May 1	False alarm. Clothing under building.	do. Private.	12,350.00 50.00	1.00 35.00 45.00	Explosion of lamp. Incendiary.	Burning articles removed. Beat out.
Toro Point. Gorgona. Empire. Colon. Gorgona. Do. Culebra.	May 2 May 5 May 10 May 18 May 25 May 28 do.	Coconut tree. False alarm. Store and dwelling. Quarantine station. Lumber. Dump. Dwelling.	Isthmian Canal Commission. Private. Isthmian Canal Commission. do. Isthmian Canal Commission.			Electric wires. Ignition of gasoline. Lighted cigarette. Fire in dump. Spontaneous combustion.	Tree cut down. Lines of hose. Fire extinguisher. Line of hose. Do. Burning articles removed.



TABLE 52.—*Statement of receipts and disbursements, July 1, 1912, to June 30, 1913.*

[Includes revenues, postal and trust funds.]

	Balance on hand—	
	July 1, 1912.	June 30, 1913.
On deposit with—		
Commercial National Bank, Washington, call account.....	\$528,310.57	\$738,929.58
Riggs National Bank, Washington—		
Call account.....		1,000,000.00
Checking account.....	799,490.62	239,571.26
International Bank, Panama, Republic of Panama, checking account.	44,378.72	46,517.37
Cash in vault at Empire, Canal Zone.....	33,879.77	78,251.11
Total.....	1,406,059.68	2,103,269.32
	Receipts.	Disbursements.
July, 1912.....	\$380,293.32	\$298,953.40
August, 1912.....	381,880.50	335,185.63
September, 1912.....	382,027.81	280,543.69
October, 1912.....	391,225.64	453,833.65
November, 1912.....	435,071.59	318,635.80
December, 1912.....	455,960.91	373,912.31
January, 1913.....	448,295.92	378,049.70
February, 1913.....	476,797.61	385,620.55
March, 1913.....	450,327.75	349,681.28
April, 1913.....	443,400.27	420,340.20
May, 1913.....	418,581.53	401,213.30
June, 1913.....	430,669.36	401,353.06
Total.....	5,094,532.21	4,397,322.57

## APPENDIX O.

### REPORT OF HON. FRANK FEUILLE, HEAD OF THE DEPARTMENT OF LAW.

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ISTHMIAN CANAL COMMISSION,  
DEPARTMENT OF LAW,  
*Ancon, Canal Zone, August 11, 1913.*

SIR: I have the honor to submit the following report of the business transacted by the department of law for the fiscal year ended June 30, 1913.

The personnel of the department was increased by one clerk and a land inspector during the latter part of the fiscal year just ended, due to the additional work assigned to this office in connection with the depopulation of the Canal Zone under the Executive order of December 5, 1912; and in representing the United States before the joint land commission, which has been in session on the Isthmus since the 28th of February last, adjudicating land claims.

The duties assigned to the department of law by Executive orders and ordinances are such as ordinarily belong to a chief law officer of the Government—that is, the department has charge of all of the civil cases of the Isthmian Canal Commission and the government of the Canal Zone, as well as the prosecution of all crimes and misdemeanors in the supreme and circuit courts of the Canal Zone, and the head of the department and his assistants have been called upon to give many opinions to the chairman and chief engineer and the various departmental chiefs.

Land matters of the Isthmian Canal Commission and the Panama Railroad Co. are under the jurisdiction of this department, and are managed by a land agent, who has charge of lands belonging to the Government of the United States, and to the Panama Railroad Co. in the cities of Panama and Colon as well as in the Canal Zone.

In addition to these duties, the head of the department has rendered special services on committees and in connection with the official transactions of the chairman with the authorities at Washington and the Republic of Panama. An important part of this related to legislation enacted by the President for the Canal Zone.

In anticipation of the inundation of the Gatun Lake area, a number of the towns along the line of the Panama Railroad between Gorgona and Gatun were cleared of their population. As a result, an Executive order was issued on September 2, 1912, by which the administrative district of Gorgona was abolished and its territory added to the district of Empire for judicial, administrative, and political purposes; and the functions of the various officials of the Gorgona district were transferred to those of the district of Empire. The areas of Gatun Lake lying outside of the east and west lines of the Canal Zone proper and the lands adjacent to said areas up to contour lines of 100 feet above

mean sea level, were included in the administrative district of Cristobal, and in the third judicial circuit for all judicial, administrative, and political purposes, except that part of the Chagres River and its confluences from the point where the said river intersects the eastern line of the canal proper, thence to the eastward up to contour lines of 100 feet above mean sea level, which is included in the administrative district of Empire and in the second judicial circuit for such purposes. The order also abolished the office of senior district judge and reduced the number of district judges to three.

The Panama Canal act, approved August 24, 1912, authorized the President to declare that all lands and land under water within the limits of the Canal Zone are necessary for the construction, maintenance, operation, sanitation, and protection of the Panama Canal. The President, pursuant to that act, issued an Executive order of December 5, 1912, directing the chairman and chief engineer of the Isthmian Canal Commission to take possession on behalf of the United States of all land and land under water within the limits of the Canal Zone and to extinguish, by agreement when practicable, all claims and titles of adverse claimants to the occupancy of land and land under water.

An amendment of the Executive order of July 21, 1912, was made by the President's order of January 13, 1913, to cure the inequalities of the first order respecting the inspection fees to be charged small vessels. The original order treated large vessels on the same terms with small ones, which was deemed unfair to the latter. The amending order made the law more explicit regarding the equipment with which steam vessels must be provided to secure the safety of passengers and crew.

Negotiations have been pending between the United States and the Republic of Panama for the exchange of the lands known as Las Sabanas, lying contiguous to the city of Panama in the Canal Zone, for certain harbor areas in the city of Colon. In consequence, the President deemed it proper to except the Sabanas lands from the provisions of the Executive order of December 5, 1912, directing the chairman of the Isthmian Canal Commission to take possession on behalf of the United States of all privately owned lands in the Canal Zone. This was done by Executive order of February 18, 1913. The lands so excepted contain an area of about 7 square miles.

In order that birds on the Canal Zone might be properly protected from wanton killing or injury, an Executive order on the subject was submitted to the President and signed by him on March 19, 1913. The order makes it unlawful for any person to hunt, trap, capture, willfully disturb, or kill any bird of any kind whatever, or to take the eggs of any bird, except in the form and manner permitted by the regulations provided for by the order. In conformity with this order, suitable regulations have been drafted by a committee and submitted to the chairman for enactment by the Isthmian Canal Commission, and it is believed that this order and the regulations to be established under it will protect birds and their nests from wanton destruction or molestation, and at the same time the hunting of game birds within proper limitation will be permitted. The Executive order provides for a fine of not to exceed \$100 or imprisonment in jail for not more than 30 days for every offense.



For a number of years the Canal Zone has had a special system for the administration of the estates of deceased and insane employees of the canal commission and the Panama Railroad Co., under which the collector of revenues acts as public administrator for such estates when no regular administrator or guardian has been appointed. The maximum value of an estate coming within the jurisdiction of the collector of revenues was first fixed at \$500, but the amount was increased from time to time by amending Executive orders until finally the limit as to the value was removed entirely by the Executive order of February 5, 1912. The collector of revenues may now administer such estates when they consist of personal property only, regardless of the value of the estates. Under the present state of the law in the Canal Zone, the estates of deceased or insane employees of the canal commission, the Canal Zone government, and the Panama Railroad Co. are administered by the collector of revenues free of cost. The actions of the collector are subject to the supervision and approval of the circuit court of the first judicial circuit of the Canal Zone. The collector is authorized to collect all moneys due to the deceased or insane employee, pay his debts, and deliver the residue of the estate to the heirs or other persons lawfully entitled to it.

Complaints were made from time to time that the agents of foreign corporations whose financial condition was doubtful were doing business in the Canal Zone. To prevent exploitation of Government employees and others by such agents, an Executive order was issued by the President on March 20, 1913, requiring foreign corporations or joint-stock companies, including those organized under any State or Territory of the United States, to file their articles of incorporation with the collector of revenues for the Canal Zone, accompanied by a statement verified by the oath of the president or secretary of the company and attested by a majority of the board of directors, containing certain information therein provided for, upon which the collector of revenues might base a conclusion as to the solvency of the concern. In addition to this, foreign corporations are required to file authorization with the collector of revenues to represent them in all suits and legal proceedings in the Canal Zone, and to pay an annual tax of \$50. The order has had a salutary effect in keeping out undesirable concerns, but it is believed to be too broad in its scope and includes companies that operate in the Canal Zone by reason of contracts with the Panama Railroad Co., as well as some that are here by previous permission of the canal authorities. It would seem desirable to limit the effect of the law to concerns that have not been invited to the Canal Zone by any of the governmental agencies.

On April 15, 1913, the President issued an Executive order to establish maritime quarantine regulations for the Canal Zone and the harbors of the cities of Panama and Colon, Republic of Panama, these regulations to take effect upon the date on which the Panama Canal is officially and formally opened for use and operation by proclamation of the President of the United States. The regulations were promulgated in advance of the opening of the canal in order that shipping interests and the traveling public may have information in regard to the quarantine requirements of the Panama Canal and the Canal Zone.

Section 2 of the Panama Canal act, approved August 24, 1912, confirms as valid and binding all laws, regulations, and ordinances adopted and promulgated in the Canal Zone by order of the President for the government and sanitation of the Canal Zone and the construction of the Panama Canal. The effect of this provision is to set at rest whatever doubts may have existed as to the authority of the President to enact laws for the government of the Canal Zone since the expiration of the Fifty-eighth Congress.

#### PROSECUTING ATTORNEY'S OFFICE.

No changes have been made in the office of the prosecuting attorney. Criminal business in the courts of the Canal Zone is in charge of the prosecuting officers of the Isthmian Canal Commission, under the supervision of the head of the department of law. The prosecuting attorney is devoting his time almost exclusively to land matters and land claims, and especially those coming before the joint land commission, and in consequence the prosecution of criminal cases is conducted by the assistant prosecuting attorney. I submit the following information in respect to the criminal cases in the circuit courts and the supreme court of the Canal Zone for the fiscal year ended June 30, 1913, furnished to me by the assistant prosecuting attorney:

#### CRIMINAL CASES IN THE CIRCUIT COURTS.

During the fiscal year 621 criminal cases have been disposed of. In the first circuit there were 288; in the second circuit, 178; and in the third circuit, 155.

Of the total, 449 were convicted, 111 were acquitted, 54 were dismissed, and in 7 cases the defendants forfeited bail and are fugitives.

The following is a tabulated statement showing the various offenses for which there have been prosecutions and the number of defendants charged with these various offenses:

Adultery.....	18
Arson.....	1
Assault and battery.....	51
Assault with a deadly weapon.....	27
Assault with intent to commit murder.....	4
Assault with intent to commit felonies other than murder.....	5
Burglary.....	53
Cheats.....	5
Disorderly conduct.....	27
Embezzlement.....	24
False personation.....	3
Forgery.....	24
Gambling.....	100
Grand larceny.....	124
Incest.....	2
Liquor laws, violation of.....	9
Manslaughter.....	5
Mayhem.....	1
Murder.....	2
Murder, second degree.....	1
Navigation rules, violation of.....	19
Perjury.....	1
Petit larceny.....	27
Rape.....	3
Receiving stolen property.....	2

Returning to Canal Zone after deportation.....	13
Rioting.....	8
Miscellaneous.....	62
<b>Total.....</b>	<b>621</b>

## Disposition:

Convicted.....	449
Acquitted.....	111
Dismissed.....	54
Fugitives.....	7
<b>Total.....</b>	<b>621</b>

## Number by circuits:

First.....	288
Second.....	178
Third.....	155

For the purpose of comparison, similar tabulated statements for the fiscal years ended June 30, 1911, and June 30, 1912, are given below:

*Criminal cases in the circuit courts of the Canal Zone during the fiscal year July 1, 1911, to June 30, 1912.*

Adultery.....	9
Arson.....	5
Assault and battery.....	28
Assault with a deadly weapon.....	67
Assault with intent to commit murder.....	4
Assault with intent to commit felonies other than murder.....	5
Burglary.....	62
Cheats.....	13
Disorderly conduct.....	17
Embezzlement.....	24
Forgery.....	17
Gambling.....	66
Grand larceny.....	107
Manslaughter.....	4
Murder.....	3
Navigation laws, violation of.....	26
Perjury.....	6
Rape.....	7
Resisting, etc., public officer.....	17
White-slave traffic.....	6
Miscellaneous.....	122
<b>Total.....</b>	<b>615</b>

## Disposition:

Convicted.....	398
Acquitted.....	139
Dismissed.....	66
Fugitives.....	12

**Total..... 615**

## Number by circuits:

First.....	160
Second.....	333
Third.....	122

**Total..... 615**

*Criminal cases in the circuit courts of the Canal Zone during the fiscal year July 1, 1910, to June 30, 1911.*

Adultery.....	18
Assault and battery.....	33
Assault with a deadly weapon.....	41
Burglary.....	52
Disorderly conduct.....	12
Embezzlement.....	27
False personation.....	10
Forgery.....	14
Grand larceny.....	59
Manslaughter.....	8
Murder.....	2
Perjury.....	5
Resisting arrest.....	7
Miscellaneous.....	55
<b>Total.....</b>	<b>343</b>
<hr/>	
Disposition:	
Convicted.....	236
Acquitted.....	79
Dismissed.....	27
Fugitives.....	1
<b>Total.....</b>	<b>343</b>

While it appears that there was a total of 615 cases last year as compared with 621 this year, there has in reality been a slight decrease in crimes generally. The apparent increase is due to the fact that there were 100 defendants prosecuted for gambling this year, and 66 last year.

There was a slight increase in the percentage of convictions this year over last year.

At the end of this fiscal year there were 3 criminal cases pending in the circuit courts. They were pending because the informations had been recently filed and, under the law, could not be tried before.

There is some discrepancy between the figures of this department and those of civil administration relating to criminal cases. Civil administration shows the number of cases filed during the year, whereas this office shows the number of cases disposed of. Civil administration also reports the number of cases, whereas this office keeps the record according to the number of defendants. We are compelled to keep it according to the number of defendants for several reasons. We have to keep a record of the name of each defendant and what disposition was made of his individual case. In some cases several defendants are tried together, and it is necessary to keep the records according to the defendants because where several are tried together some may be convicted and others acquitted, and in order to show convictions and acquittals the cases must be counted according to the defendants.

There may also be a discrepancy as to the number of cases pending at the end of the fiscal year. According to civil administration, a case is pending in the circuit courts as soon as it has been sent up from the district courts, but this office does not show a case pending until the district court papers reach this office and an information is filed in the circuit court.

## CRIMINAL CASES IN THE SUPREME COURT.

Three criminal cases were heard upon appeal and disposed of in the supreme court. In two of these the judgment of the lower court was affirmed, and in the other there was a reversal.

There was also in the supreme court a disbarment proceeding against an attorney of the Canal Zone, and the defendant was disbarred from practice.

## CIVIL CASES.

The following civil cases in which the United States of America, the Isthmian Canal Commission, or the Panama Railroad Co. were interested have been disposed of during the fiscal year.

## IN THE FIRST CIRCUIT.

*Blandina Edghill v. R. Kiely (Canal Zone policeman).*—This was a suit for \$500 damages to personal property. The action complained of was performed by R. Kiely in the exercise of his functions as a police officer, and for that reason he was defended before the courts by the law officer of the Government. Complaint was filed November 14, 1912; answer filed November 30, 1912. On December 21, 1912, trial was had, which resulted in a judgment in favor of plaintiff for \$15 and costs.

## IN THE SECOND CIRCUIT.

*J. G. Duque v. S. Delvalle.*—This was an action for forcible entry and detainer against a tenant of the Isthmian Canal Commission. In order to protect the canal commission's possession held by the tenant, it was deemed proper to have the prosecuting attorney represent the defendant in this case. On August 6, 1912, trial was had, which resulted in a judgment for defendant, and thus the Government's possession of the land was protected.

*United States of America v. Regina M. Silva.*—Several years ago Regina M. Silva died without heirs. She had a claim to the Cano Quebrada tract of land in the Canal Zone. Escheat proceedings were instituted in the circuit court of the second judicial circuit on August 11, 1911, for recovery of the lands in favor of the public schools of the Canal Zone in conformity with local laws. There were no claims against the estate except one on account of the last sickness and funeral, amounting to about \$700. An adverse claim was set up by others, and it seemed probable that this adverse claim might prevail over the claim of the Government in the escheat proceedings. It was therefore deemed advisable to purchase the adverse claim for the Government of the United States, pay the indebtedness due for the last sickness and funeral expenses of Miss Silva, and dismiss the escheat proceedings. It is believed that the United States will not henceforth be disturbed in its possession or title to the property.

*Sofia Amos v. William A. Garlow.*—This was a suit against a Canal Zone policeman for \$2,000 for trespass. The action of the policeman complained of was performed in the line of service, and for that reason a law officer of this department represented him at the trial. Complaint was filed February 14, 1913; answer filed March 8, 1913, and on April 11, 1913, trial was had, which resulted in a judgment for the defendant.

## IN THE THIRD CIRCUIT.

*Eusebio Morales et al. v. Ruben S. Arcia et al.*—This was a suit instituted by Eusebio Morales and others against Ruben S. Arcia and others for partition of lands lying between Gatun and Colon. On December 15, 1910, the Panama Railroad Co. and the Isthmian Canal Commission intervened, the former seeking relief against the plaintiffs and defendants for recovery of the land, and the extinguishment of any claims set up by them; while the Canal Commission sought to obtain an injunction against the plaintiffs and defendants to prevent them from disturbing lands belonging to the United States and in the possession of the Isthmian Canal Commission.

The case was tried, and on May 31, 1913, an opinion was rendered by the court, giving certain portions of the land to the plaintiffs and defendants and other portions to the Panama Railroad Co. and the Isthmian Canal Commission. No decree has yet been rendered on the opinion. The trial judge has been absent on vacation, and now that he has returned it is expected that he will enter up a decree in the near future. The opinion of the court does not give the Panama Railroad Co. and the Isthmian Canal Commission all of the relief asked for in the pleas of intervention, and an appeal will probably be taken to the supreme court of the Canal Zone when the decree of the court is entered.

The case of Pedro Celestino Cerezo *v.* Eusebio Diaz and others, in which the United States and the Panama Railroad Co. are interveners, remained undisposed of at the end of the fiscal year. This case has been pending in the circuit court of the third circuit since June 24, 1909, and involves land at the mouth of Sweetwater River on Toro Point, across the bay from Colon, and includes part of lot 1 of the Harrison-Arosemena map, granted to the Panama Railroad Co. by the Colombian Government. On August 5, 1909, special appearances for the United States and Panama Railroad Co. were entered. Negotiations for a compromise of the case have been pending for some time, but no definite conclusion in respect to them has been reached. These negotiations have caused the case to be continued from time to time.

## LAND MATTERS OF THE ISTHMIAN CANAL COMMISSION.

The work of clearing the Gatun Lake area of population was extended during the fiscal year to the regions outside of that area, to meet the necessities of construction and in conformity with the order of December 5, 1912, providing for the depopulation of the Zone. In the work of clearing these areas of population, a large number of claims of squatters or occupants was adjusted by this department. I submit a tabulated statement of such claims furnished to me by the land agent.

Location.	Number of claims.	Amounts.
Settlements on account of clearing area for Toro Point Military Reservation.....	31	\$5,578.00
Site cleared for oil tanks, Mount Hope.....	14	2,115.00
Gatun Lake area settlements (including Chagres and Trinidad Rivers).....	5	214.50
Miscellaneous settlements (including settlements made in connection with construction of Empire-Gamboa Road, installation of Toro Point telephone line and Mount Hope pumping plant, etc.).....	18	466.00
Gold Hill settlements on account of sluicing plant operations.....	23	727.50
Area between Gatun and Gamboa, and eastern boundary of Canal Zone and canal.	62	2,403.00
Bailamonos lands.....	3	60.00
United States lands at Matachin.....	3	300.00
Matachin lands claimed by heirs of Bosque.....	106	9,080.00
On tract No. 21, United States Government lands west of Empire, Las Casca-das, etc.....	140	6,662.50
Total.....	405	27,606.50

A considerable number of other claims had been adjusted just before the end of the fiscal year, and payments have since been made to many of the claimants and their cases finally settled.

All of the foregoing claims were paid directly to the claimants by the Isthmian Canal Commission, no settlements having been effected by the Panama Railroad Co. for the account of the commission as has been done in previous years.

In addition to the settlements with occupants and squatters, the following purchases of lands were made:

Deeds were acquired to the portions of the following tracts not heretofore acquired by the Panama Railroad Co. or the United States: Cano Quebrado, Barro Colorado Abajo, Penas Blancas Abajo, Penas Blancas Arriba, Bohio Soldado or Monte Criste, Ahorca Lagarto, and Bohio Soldado; also a small holding, consisting of school building in the town of Limon.

These portions include a settlement made between Porfirio Melendez and the Panama Railroad Co., whereby his interest and that of his family, heretofore in dispute with the Panama Railroad Co., were finally adjudicated, and reference is here made to the various deeds involved in the transaction between Mr. Melendez and the agents of the Isthmian Canal Commission and the Panama Railroad Co. for full particulars.

In addition to the foregoing portions of lands, quitclaims were obtained for the United States for the holdings of Mr. Santiago Samudio at Santa Isabel, El Encanto, Victoriano, and Paja.

The aggregate price paid for all of the foregoing lands and interest in lands amounted to \$28,854.74.

The depopulation of the Canal Zone made it necessary to cancel the remaining Isthmian Canal leases. The work of the cancellation of leases commenced in 1910, when all of the leases in the lake area were terminated, but the lessees were permitted to remain on the land at their own risk to harvest their crops until disturbed by the waters of the lake to be formed by Gatun Dam. Since that time leases have been canceled in other districts, and on March 31, 1913, all unexpired canal commission leases for building lots and agricultural property were terminated by the authority of the chairman and chief engineer. The cancellation, however, did not include revocable licenses, which may be canceled at any time, nor did it include lease No. 4373, in the name of F. Solorzano, for a piece of ground located south of the Balboa Road within the limits of the city of Panama, which lease

expires on January 29, 1914. On March 31, 1913, there were 174 leases, covering 99 hectares of agricultural land and 108 building lots, which would have been in force on June 30, 1913, were it not for the order of cancellation.

The total number of revocable licenses in force on June 30 was 312, covering 347 building lots, bringing in a total amount of annual rental of \$2,816.96. I submit herewith a tabulated statement of revocable licenses still in force.

District.	Number of revocable licenses.	Number of building lots.	Amount of annual rental.
Ancon.....	1	11	\$1.00
Empire.....	311	346	2,815.96
Total.....	312	347	2,816.96

<sup>1</sup> Church lot.

#### PANAMA RAILROAD CO. MATTERS.

The head of the department of law, the prosecuting attorney, and the assistant prosecuting attorney are required to render legal services to the Panama Railroad Co., and a Latin-American lawyer is regularly retained by the Panama Railroad Co. to appear before the courts of the Republic of Panama on behalf of the company, under the direction of the head of this department. All of the legal business of the railroad company on the Isthmus, constructive and advisory, and the prosecution and defense of the company's interests before the courts is in charge of this department. Claims and suits against the Panama Railroad Co. for personal injury have increased very materially during the past year. Many claims have been compromised in this office and suit thereon averted. The cases that have been brought against the Panama Railroad Co. in the various courts of the Canal Zone during the fiscal year just passed are the following:

#### CIRCUIT COURTS.

##### IN THE FIRST CIRCUIT.

*Duncan Hoffman v. Panama Railroad Co.*—This was a suit for \$5,000 damages for personal injuries to an employee. Complaint was filed August 5, 1912; answer was filed August 31, 1912. On September 23, 1912, there was a trial, which resulted in a judgment for the defendant.

*George Dean v. Panama Railroad Co.*—This was a suit for \$5,000 damages for personal injuries to an employee. Complaint filed November 15, 1912; answer filed November 30, 1912. On December 21, 1912, trial was held, which resulted in a judgment for defendant.

*M. Carmelo v. Panama Railroad Co.*—This was a suit for \$900 damages to carriage and horses. Complaint filed February 24, 1913; answer filed March 6, 1913; and on April 19, 1913, trial was had, which resulted in a judgment for defendant.



## IN THE SECOND CIRCUIT.

*Thull, Administrator, v. Panama Railroad Co.*—This was a suit for \$20,000 for death of an employee. The complaint was filed April 9, 1912; answer was filed on April 27, 1912. There was a demurrer to the complaint, and on September 7, 1912, trial was had, which resulted in judgment for defendant. There was a motion for a new trial, which was overruled, and plaintiff appealed to the supreme court.

*Chrissie Sadler, wife of Joseph Sadler, deceased, v. Panama Railroad Co.*—This was a suit for \$50,000 damages for death of husband, who was a passenger. Complaint was filed May 24, 1912; answer filed June 29, 1912. On February 14, 1913, trial was had, which resulted in a judgment for the defendant.

*John Fordigal v. Panama Railroad Co.*—This was a suit for \$2,500 damages for personal injuries to employee. Complaint was filed August 1, 1912; answer filed August 31, 1912; and on October 4, 1912, trial was had, which resulted in a judgment for the defendant.

*George Blake v. Panama Railroad Co.*—This was a suit for \$1,000 damages for personal injuries to passenger. Complaint was filed November 12, 1912; answer filed December 10, 1912; and on January 31, 1913, complaint was dismissed.

*Evans Weeks v. Panama Railroad Co.*—This was a suit for \$10,000 for personal injuries to employee. Complaint was filed November 12, 1912; answer filed December 2, 1912; and on January 3, 1913, trial was had, which resulted in a judgment for plaintiff for \$5,000. A motion for a new trial was made and overruled, and defendant appealed to the supreme court.

*Leon Jean v. Panama Railroad Co.*—This was a suit for \$10,000 for personal injuries to employee. Complaint was filed January 10, 1913, and on May 31, 1913, case was compromised by the payment of \$1,800 to plaintiff.

## IN THE THIRD CIRCUIT.

*Terry and wife v. Panama Railroad Co.*—This was a suit for \$2,000 for personal injuries to wife. The complaint was filed September 12, 1912; answer filed October 2, 1912; and on November 1, 1912, trial was had, which resulted in a judgment for defendant. Plaintiff made a motion for a new trial, which was overruled, and case was appealed to the supreme court.

Two cases remain in the circuit courts undisposed of at the end of the fiscal year, as follows:

*James Arthurton v. Panama Railroad Co.*—This is a suit for \$10,000 damages for personal injuries to employee. The complaint was filed November 15, 1912, and answer filed December 2, 1912. Subsequently an amended complaint was filed, and has been continued from term to term on motion of plaintiff.

*Hezekiah Carter v. Panama Railroad Co.*—This is a suit for \$5,000 damages for personal injuries to employee. Complaint was filed on April 28, 1913. There was a demurrer by the defendant, which was sustained. An amended complaint was filed, and on June 23, 1913, defendant filed its answer, and the case was set down for hearing on July 3, 1913.

Other civil suits were instituted against the Panama Railroad Co. in addition to the personal injury cases above mentioned, as follows:

IN THE SECOND CIRCUIT.

*Murray & Fuller v. Panama Railroad Co.*—This was a suit for \$750 damages to freight shipped on the Panama Railroad. Complaint filed April 19, 1913; answer filed May 15, 1913, and on June 24, 1913, trial was had, which resulted in a judgment for plaintiff for \$25 and costs.

IN THE THIRD CIRCUIT.

*Dannis v. Panama Railroad Co.*—This was a suit for \$249.60 damages for loss of freight. The complaint was filed July 26, 1912; answer filed August 20, 1912, and on October 10, 1912, the suit was dismissed.

The case of Pedro Celestino Cerezo *v.* Eusebio Diaz and others has been referred to in this report, inasmuch as it also affects the interest of the United States to the lands involved in the case. The chief contention, however, between Cerezo and those claiming with him is against the Panama Railroad Co. The negotiations for compromise already referred to related chiefly to the interests of the Panama Railroad Co., the purpose of the law officers of the Isthmian Canal Commission being to effect a compromise so as to deed some of the Panama Railroad land fronting on the bay to the adverse claimants in full satisfaction of their claim against the Panama Railroad and the United States. The Executive order of the President ordering the depopulation of the Zone caused this office to discontinue the negotiations.

IN THE FIRST CIRCUIT.

*Lefevre, attorney in fact for De La Ossa et al., v. Panama Railroad Co. et al.*—This suit was to establish the boundaries of lands known as "La Iseca." Complaint was filed October 5, 1912, and answer filed November 22, 1912. Since the end of the fiscal year, however, the plaintiff has dismissed the suit without prejudice.

Proceedings were instituted on behalf of the Panama Railroad Co. in the following cases:

*Panama Railroad Co. v. Mendez et al.*—This is a suit to recover a tract of land lying northeast of the city of Colon, consisting of about 10,000 acres, and was part of the lands originally granted to the Panama Railroad Co. by the Government of New Granada, now Colombia. The complaint was filed March 21, 1912, and demurrer was interposed by the defendants and overruled, and they were required to answer by July 1, 1912. The case has been continued from time to time by the defendants, but I am hopeful that a trial will be obtained in the near future.

*Panama Railroad Co. v. Villalobos et al.*—This is a suit to recover a strip of land on the shore of Limon Bay. Complaint was filed on March 21, 1912; a demurrer was filed by defendants, which was overruled and the defendants required to answer July 1, 1912. This case has been continued from term to term on the motion of the defendants. The interest of Mr. Porfirio Melendez in this litigation was adjusted together with the other issues between him and the

Panama Railroad Co. in the settlement made under the deeds already mentioned in this report, by which he conveyed the lands to the United States.

SUPREME COURT.

Two cases against the Panama Railroad Co., on account of personal injuries, were disposed of in the supreme court of the Canal Zone during the fiscal year, as follows:

*Fitzpatrick v. Panama Railroad Co.*—This was a suit for \$10,000 damages for personal injury. The case was tried in the circuit court of the third judicial circuit which resulted in a judgment for plaintiff of \$7,000. An appeal was entered in the supreme court on August 6, 1912. The appeal was heard December 14, 1912, and on January 31, 1913, the supreme court rendered a decision in which the judgment of the lower court was affirmed.

*Terry and wife v. Panama Railroad Co.*—This was a suit for \$2,000 for personal injuries to wife, brought in the circuit court of the third judicial circuit. Plaintiffs' appeal was entered in the supreme court on February 8, 1913. On March 28, 1913, the supreme court rendered a decision in which the judgment of the circuit court was affirmed.

There was left pending against the Panama Railroad Co. in the supreme court the following cases:

*Thull, administrator, v. Panama Railroad Co.*—This was a suit for \$20,000 which was tried in the second circuit court and resulted in a judgment in favor of the defendant. Plaintiff appealed to the supreme court and the appeal was entered on March 15, 1913; the case was heard on May 4, 1913. No decision has yet been rendered by the supreme court.

*Evans Weeks v. Panama Railroad Co.*—This is a suit for \$10,000 for personal injuries to employee, which was tried in the second circuit court and resulted in judgment for plaintiff for \$5,000. It was appealed to the supreme court and the appeal filed May 16, 1913. The appeal will be heard in the ensuing July term.

PANAMA RAILROAD LANDS.

The Panama Railroad Co. has large tracts of land in the Canal Zone, acquired by grant from the Government of New Granada, now Colombia, by virtue of the company's concession from that Government, and in addition has several land holdings acquired by purchase and condemnation proceedings.

Some of the company's land obtained by grant from the Colombian Government is now in litigation, as already appears from other parts of this report.

The railroad company has the usufruct in the island of Manzanillo, upon which the city of Colon is situated, except 4 hectares, or 10 acres, which were reserved by the Colombian Government for public purposes. The Panama Railroad Co. has divided the island into lots in municipal order and is leasing the greater portion of the city to private parties.

The railroad company also has a large number of lots in the city of Panama, in addition to the area occupied by the company for a railroad yard and other purposes. These lots are also leased by the Panama Railroad Co. to private individuals, with the exception of some that are leased to the Panaman Government.

The railroad company derives considerable revenue from leases and licenses on the above-mentioned properties. The following is a report of land agent of the leasing of Panama Railroad properties and the rentals derived therefrom for the last fiscal year:

During the past year there has been increase in the number of lots leased in Colon, due to the fact that lots on the east side of E street have been approved for building. On account of this additional leasing of lots, an increase of approximately 15 per cent over last year's approximated rentals has accrued to the railroad company.

At Fox River a few additional lots have been leased during the past year, increasing the rental from this district slightly.

At Gatun the rentals remained practically the same, there being a slight decrease due to the fact that Mr. Stilson's lease for those lots in blocks 2 and 4 not already constructed upon was canceled several months ago.

New Frijoles leases remain practically the same.

The rental for the town of Monte Lirio decreased slightly, due to the fact that certain parties gave up their leases on lots.

Empire and Culebra districts remained practically the same.

At Panama a slight increase in rentals was made, due to the fact that additional lots in the district of Guachapali have been leased, which lots were previously held open by the proposed transfer of certain property in Panama between the Panaman Government and the Panama Railroad Co.

As to the agricultural leases, there was only a slight increase in their number, these being made with parties occupying property at Majagual and Puerto Escondido. While the total land rental from this property shows as being \$1,422.70, nevertheless very little rental has been collected on this property, as it was simply desired to get leases signed on account of pending suits between the Panama Railroad Co. and various individuals claiming ownership in this land.

The revocable licenses for land on the east side of the canal, opposite Culebra and Empire, remain about the same as on June 30, 1912. No rental has ever been collected from parties holding land on this property. This form of revocable license is executed with them for the purpose of having the railroad recognized as the owner of this property, known as the Huertas-Honduras tract.

During the month of April, 1913, all leases for lots and agricultural land at Toro Point, Sweetwater, etc., were canceled on account of the clearing of the Canal Zone. Therefore, no rental is being derived from this property.

Reports from this office to the New York office of the Panama Railroad Co. as to the number of new leases executed show that during the year from July 1, 1912, to June 30, 1913, the total number was 138, covering 227 new lots in Panama and Colon.

The approximated total annual rental value is shown as amounting to \$143,496.57, although this is not the actual collection made. This amount is merely an approximated rental value for the year, were the Panama Railroad Co. collecting rentals on all properties at the rates shown on our record books on June 30, 1913. The total rental actually collected during the past fiscal year from all sources amounts to \$134,359.57, which figure has been furnished by the local auditor of the Panama Railroad Co.

*Tabulated statement of Panama R. R. leases in effect July 1, 1912, to June 30, 1913.*

	Leases, June 30—		Lots, June 30—		Rental, June 30—	
	1912	1913	1912	1913	1912	1913
Colon.....	682	772	680	807	\$75,470.60	<sup>1</sup> \$90,790.28
Fox River.....	65	71	64	70	3,120.20	4,157.00
Gatun.....	157	157	185	170	5,766.80	5,751.80
New Frijoles.....	24	24	27	27	377.00	377.00
Monte Lirio.....	14	10	19	15	522.00	414.00
Empire.....	403	403	441	441	12,819.60	12,819.60
Culebra.....	313	308	324	316	6,870.40	6,774.40
Panama.....	366	378	437	445	19,823.06	20,989.79
Scattering <sup>2</sup> .....	60	.....	60	.....	447.30	.....
Agricultural.....	228	232	228	232	1,405.20	1,422.70
Total.....	2,312	2,355	2,465	2,523	126,622.16	143,496.57

<sup>1</sup> Includes rental from offices in concrete building, Colon, \$7,935 annual rental at rates in force June 30, 1913.

<sup>2</sup> Included in various districts, instead of being made separately, for the year July 1, 1912, to June 30, 1913.

*Miscellaneous lots leased.*

Churches.....	57
Parks.....	4
Schools.....	10
Fire stations.....	4
Municipal wash house.....	1
Total.....	76

There are no cases against the Panama Railroad Co. pending in the courts of the Republic of Panama. Those that were left undisposed of at the time the last annual report of this department was made have been terminated favorably to the Panama Railroad, with the exception of the case of lot B, Juan Ponce, in the city of Panama. In that case the judgment for the possession of the lot was given in favor of the adverse party, as well as for rents for several years past. The lot was of very small dimensions, and on the suggestion of this office the case was compromised by the railroad company relinquishing all its interest in the lot to the adverse claimant, and the latter in turn released the Panama Railroad Co. for his claim of rentals under the judgment. As I have already stated, the issues in the other cases were disposed of favorably to the Panama Railroad Co.

Respectfully,

FRANK FEUILLE,  
*Head of Department of Law.*

Col. GEORGE W. GOETHALS, United States Army,  
*Chairman and Chief Engineer, Culebra, Canal Zone.*



## APPENDIX P.

### REPORT OF COL. W. C. GORGAS, MEDICAL CORPS UNITED STATES ARMY, MEMBER ISTHMIAN CANAL COMMISSION, CHIEF SANITARY OFFICER, HEAD OF THE DEPARTMENT OF SANITATION.

ISTHMIAN CANAL COMMISSION,  
OFFICE OF THE CHIEF SANITARY OFFICER,  
*Ancon, Canal Zone, July 25, 1913.*

SIR: I have the honor to submit herewith the annual report of the department of sanitation for the fiscal year ending June 30, 1913.

Statistics as to the death rate among employees of the Isthmian Canal Commission and Panama Railroad Co. for the fiscal year just closed compared with similar figures for previous years since 1906 are shown below:

Year.	White employees.			Black employees.			All employees.		
	Average number.	Total deaths.	Annual average per 1,000.	Average number.	Total deaths.	Annual average per 1,000.	Average number.	Total deaths.	Annual average per 1,000.
1906-7.....	7,727	123	15.93	24,587	1,150	45.94	32,314	1,273	39.41
1907-8.....	12,058	185	15.34	20,999	604	19.48	43,057	789	18.32
1908-9.....	12,299	147	11.95	31,962	383	11.98	44,261	530	11.97
1909-10.....	11,954	108	9.03	38,581	440	11.40	50,535	548	10.84
1910-11.....	12,891	129	10.01	36,238	428	11.81	49,129	557	11.34
1911-12.....	12,380	114	9.21	37,628	394	10.47	50,008	508	10.16
1912-13.....	12,602	94	7.46	41,398	389	9.39	54,000	483	8.94

For the same period the death rate of the total population of the cities of Panama and Colon and of the Canal Zone was as follows:

Year.	Average population.	Total deaths.	Annual average per 1,000.	Year.	Average population.	Total deaths.	Annual average per 1,000.
1906-7.....	87,215	3,670	42.08	1910-11.....	154,255	3,409	22.10
1907-8.....	112,002	3,100	27.67	1911-12.....	159,547	3,163	19.82
1908-9.....	127,362	2,807	22.04	1912-13.....	131,865	2,944	22.33
1909-10.....	144,614	2,735	18.91				

The death rate among white employees from the United States for the past six fiscal years was:

Year.	Average number.	Deaths, all cases.	Annual average per 1,000.	Year.	Average number.	Deaths, all cases.	Annual average per 1,000.
1907-8.....	5,035	41	8.14	1910-11.....	6,163	33	5.35
1908-9.....	5,126	42	8.19	1911-12.....	5,934	35	5.90
1909-10.....	5,573	31	5.56	1912-13.....	6,504	35	5.38

For the same period the death rate among the white employees from the United States and their families on the Canal Zone was:

Year.	Average number.	Deaths, all cases.	Annual average per 1,000.	Year.	Average number.	Deaths, all cases.	Annual average per 1,000.
1907-8.....	7,040	59	8.38	1910-11.....	10,500	58	5.52
1908-9.....	8,105	64	7.89	1911-12.....	10,410	66	6.34
1909-10.....	9,198	54	5.87	1912-13.....	11,087	60	5.41

Adding to the above figures the officers and men of the Tenth Infantry, the Marine Corps, and their families, the death rate was 5.40 per 1,000.

Among all employees there were during the fiscal year just closed 164 deaths from violence, as against 154 for the year 1911-12.

Deaths of employees from tropical diseases and from lobar pneumonia, pulmonary tuberculosis, and typhoid fever for the past seven fiscal years were as follows:

	1906-7	1907-8	1908-9	1909-10	1910-11	1911-12	1912-13
Dysentery.....	58	35	10	13	18	13	4
Malaria.....	205	98	47	45	41	21	12
Black-water fever.....	6	13	22	6	9	15	6
Liver abscess.....	5	11	8	6	8	7	2
Pneumonia.....	466	175	60	77	83	82	57
Pulmonary tuberculosis.....	6	60	38	51	28	26	35
Typhoid fever.....	95	42	19	16	9	8	3

The daily sick rate for employees, which includes the sick in hospitals, sick camps, and quarters, was 19.04 per 1,000, compared to 24.77 for 1910-11 and 22.91 per 1,000 for 1911-12.

The daily per capita cost of subsistence for all patients was \$0.246. The per capita cost of patients treated in hospitals was \$1.23 per day. Deducting from this amount the receipts for treatment of patients not entitled to free treatment, the net per capita cost was \$0.93 per day.

The morbidity rate of malaria is taken as an index for health conditions on the Isthmus. The following table shows the admission rate per 1,000 since 1904 of employees sick with malaria:

	Per 1,000.
1904-5.....	162
1905-6.....	727
1906-7.....	625
1907-8.....	287
1908-9.....	312
1909-10.....	183
1910-11.....	202
1911-12.....	143
1912-13.....	102



One case of yellow fever occurring on a ship from Guayaquil, Ecuador, was isolated in Santo Tomas Hospital, and died there on July 14, 1912. With this exception no cases of yellow fever, smallpox, or plague occurred on or were brought to the Isthmus during the year.

Very respectfully,

W. C. GORGAS,  
*Chief Sanitary Officer.*

Col. GEO. W. GOETHALS, United States Army,  
*Chairman and Chief Engineer, Culebra, Canal Zone.*

#### VITAL STATISTICS, FISCAL YEAR 1912-13.

##### *Deaths of employees of the Isthmian Canal Commission and Panama R. R. Co.*

Color.	Average number of employees.	Total number of deaths from—			Annual death rate per 1,000.		
		Disease.	Violence.	All causes.	Disease.	Violence.	All causes.
White.....	12,602	56	38	94	4.44	3.02	7.46
Colored.....	41,398	263	126	389	6.35	3.04	9.39
Total.....	54,000	319	164	483	5.91	3.03	8.94

##### *Deaths in the cities of Panama and Colon, and the Canal Zone.*

Place.	Population.	Deaths.	Annual average per 1,000.
Panama.....	47,172	1,413	29.95
Colon.....	20,232	493	24.37
Canal Zone.....	64,461	1,038	16.10
Total.....	131,865	2,944	22.33

NOTE.—The figures relating to the number of employees are compiled from the pay rolls of the different months of the year. The population and deaths as given for the cities of Panama, Colon, and the Canal Zone include employees and civil population.

Total admissions of employees to hospitals and sick camps, including those sick in quarters..... 33,779  
Average per 1,000 of admissions of employees to hospitals and sick camps, including those sick in quarters..... 626

*Deaths by age, color, and sex.*

Age.	White.			Colored.			Yellow.			Total.		
	Male.	Fe-male.	Total.	Male.	Fe-male.	Total.	Male.	Fe-male.	Total.	Male.	Fe-male.	Total.
Under 1 year.....	66	41	107	455	352	807	1	.....	1	522	393	915
1 to 4 years.....	21	15	36	113	95	208	.....	.....	.....	134	110	244
5 to 10 years.....	5	4	9	27	26	53	.....	1	1	32	31	63
11 to 20 years.....	6	9	15	72	47	119	1	.....	1	79	56	135
21 to 30 years.....	54	21	75	351	137	488	9	1	10	414	159	573
31 to 40 years.....	59	19	78	217	110	327	8	.....	8	284	129	413
41 to 50 years.....	38	8	46	169	57	226	7	.....	7	214	65	279
51 to 60 years.....	22	7	29	71	31	102	7	.....	7	100	38	138
61 to 70 years.....	6	4	10	40	23	63	3	.....	3	49	27	76
71 to 80 years.....	5	2	7	11	18	29	.....	.....	.....	16	20	36
81 to 90 years.....	2	.....	2	5	4	9	.....	.....	.....	7	4	11
91 to 100 years.....	.....	.....	.....	.....	2	2	.....	.....	.....	.....	2	2
101 to 110 years.....	.....	.....	.....	.....	1	1	.....	.....	.....	.....	1	1
Unknown.....	12	1	13	39	6	45	.....	.....	.....	51	7	58
Total.....	296	131	427	1,570	909	2,479	36	2	38	1,902	1,042	2,944

*Deaths by nationality.*

Nations.	Em- ployees.	Nonem- ployees.	Total.	Nations.	Em- ployees.	Nonem- ployees.	Total.
Antigua.....	10	13	23	Jamaica.....	138	474	612
Austria.....	1	1	2	Norway.....	1	.....	1
Barbados.....	100	260	360	Japan.....	.....	1	1
Bermuda Islands.....	1	.....	1	Martinique.....	19	56	75
Bolivia.....	.....	2	2	Mexico.....	.....	5	5
Chile.....	.....	4	4	Montserrat.....	5	13	18
China.....	.....	34	34	Nassau.....	4	.....	4
Colombia.....	14	96	110	Nevis.....	2	3	5
Costa Rica.....	1	6	7	Nicaragua.....	.....	4	4
Cuba.....	.....	5	5	Panama.....	17	1,183	1,200
Curacao.....	.....	3	3	Peru.....	2	7	9
Demerara.....	3	6	9	Porto Rico.....	.....	1	1
Denmark.....	1	.....	1	Portugal.....	1	.....	1
Dominican Republic.....	1	2	3	Russia.....	.....	1	1
Ecuador.....	.....	7	7	Saba.....	.....	1	1
England.....	1	4	5	Salvador.....	.....	2	2
Finland.....	1	.....	1	Scotland.....	.....	1	1
Fortune Islands.....	6	.....	6	St. Croix.....	1	.....	1
France.....	3	11	14	St. Kitts.....	6	3	9
Germany.....	.....	2	2	St. Lucia.....	11	48	59
Grand Cayman.....	.....	1	1	St. Thomas.....	.....	2	2
Greece.....	6	7	13	St. Vincent.....	11	7	18
Grenada.....	13	21	34	Spain.....	36	35	71
Guadeloupe.....	12	15	27	Trinidad.....	5	16	21
Guatemala.....	.....	1	1	Turks Island.....	2	1	3
Guiana, British.....	2	3	5	Turkey.....	1	.....	1
Haiti.....	3	9	12	United States.....	36	45	81
Holland.....	.....	2	2	Venezuela.....	1	7	8
Honduras.....	.....	2	2	West Indies.....	.....	5	5
India.....	1	1	2	Unknown.....	1	14	15
Ireland.....	1	.....	1				
Italy.....	2	8	10	Total.....	483	2,461	2,944

*Causes of deaths of employees of the Isthmian Canal Commission and Panama Railroad.*

Causes of death.	White.	Col-ored.	Total.	Causes of death.	White.	Col-ored.	Total.
DISEASE.				DISEASE—Continued.			
Alcoholism, acute and chronic.....	3	1	3	Nephritis:			
Anemia.....	1	4	5	Acute.....	2	3	5
Aneurism.....	1	7	10	Chronic.....	1	21	22
Apoplexy.....	3	1	3	Other diseases of the kid-neys and annexa.....		1	1
Appendicitis.....	2	1	3	Other forms of mental alienation.....	1		1
Bilharziasis, intestinal.....	1	1	1	Other diseases of skin and annexa.....		1	1
Biliary calculi.....	1		1	Pellagra.....		1	1
Brain:				Peritonitis, simple.....		3	3
Softening of.....	2		2	Pharynx, disease of.....		1	1
Tumor of.....		1	1	Phlegmon and cellulitis.....		1	1
Calculi of urinary pas-sages.....		1	1	Pneumonia.....		2	2
Cancer of intestines.....		1	1	Lobar.....	2	53	55
Cancer and other malig-nant tumors of stomach and liver.....	1		1	Pott's disease.....		1	1
Cancer of organs not spec-ified.....	1	1	2	Pulmonary congestion.....	1	2	3
Cerebrospinal fever.....	1		1	Pyemia.....	1	6	7
Colitis.....	1		1	Pyemia and septicemia, pneumococcic.....		4	4
Diphtheria.....		1	1	Senility.....	1	1	2
Dysentery.....		1	1	Septicemia.....		2	2
Bacillary.....		1	1	Purulent infection and.....	2		2
Entamebic.....		1	1	Spinal cord, disease of.....		2	2
Unclassified.....		1	1	Sudden death.....		1	1
Embolism and throm-bosis.....		2	2	Syphilis.....	3	1	4
Endocarditis, acute and chronic.....	1		1	Tetanus.....	1	1	2
Epilepsy.....		2	2	Tuberculosis:			
Fever:				Abdominal.....	1	3	4
Hemoglobinuric.....	5	1	6	Disseminated.....	2	24	26
Malaria.....		1	1	Miliary.....		8	8
Malaria, estivo au-tumnal.....	4	7	11	Pulmonary.....		35	35
Typhoid.....		3	3	Ulcer:			
Heart, organic disease of.....	5	18	23	Of the stomach.....	1		1
Hernia, intestinal ob-structions.....	1	1	2	Duodenal.....		4	4
Indigestion, acute.....		1	1	Urethra, diseases of.....		1	1
Infection of unknown ori-gin.....	2	2	4	Undiagnosed.....		1	1
Intestines, disease of.....		1	1				
Laryngitis.....		1	1	VIOLENCE.			
Liver:				Absorption of deleterious gases.....		4	4
Abscess of.....	1	1	2	Accidental traumatisms, various.....	14	43	57
Cirrhosis of.....		1	1	Burns and scalds.....		3	3
Disease of.....	1		1	Drowning, accidental.....	4	18	22
Abscess of.....		1	1	Dynamite explosions.....		6	6
Gangrene of.....	1	3	4	Electric shock.....		3	3
Meningitis:				Homicides.....	2	3	5
Pneumococcus.....		5	5	Poisonings, acute.....	1		1
Simple.....		4	4	Railroad accidents.....	16	39	55
Mouth and annexa, dis-ease of.....		1	1	Other external violence..	1	7	8
				Total.....	94	389	483

*Deaths of white employees from the United States.*

Name.	Division.	Time on Isthmus.	Age.	Cause of death.
<i>July, 1912.</i>				
Riley, Thomas.....	Pacific division.....	13 months...	25	Acute endocarditis.
<i>August, 1912.</i>				
Gannon, Margaret E.....	Sanitary department.....	4½ years.....	29	Acute mania.
Lockes, Charles F.....	Mechanical division.....	2½ years.....	35	Acute cardiac failure.
Painter, Joseph H.....	Atlantic division.....	4½ years.....	36	Other acute poisonings.
Strock, James Ransom.....	Mechanical division.....	5 years.....	50	Acute cholangitis.
Smith, Alfred.....	Central division.....	6 years.....	47	Chronic nephritis.
<i>September, 1912.</i>				
Fay, Lawrence B.....	Chief engineer's office.....	1½ years.....	28	Traumatism by fall.
Hanley, Wm. H.....	Pacific division.....	5 days.....		Railroad traumatism.
Ray, Edward.....	McClintic-Marshall Co.....	19 months...	40	Acute alcoholism.
<i>October, 1912.</i>				
Frost, Walter B.....	Engineering and construction.	2 years.....	23	Tubercular peritonitis.
Reed, W. F.....	Pacific division.....	1½ years.....	29	Acute alcoholism.
Stannage, Thomas.....	Chairman's office.....	1 day.....	45	Purulent infection and septicemia.
<i>November, 1912.</i>				
Purcell, John J.....	Mechanical division.....	4½ years.....	44	Railroad traumatism.
<i>Decembers 1912.</i>				
May, Duncan.....	Mechanical division.....	6½ years.....	32	Accidental drowning.
Wood, Benj. F.....	Police department.....	7 years.....	38	Softening of brain.
<i>January, 1913.</i>				
Cunningham, Leslie C.....	Mechanical division.....	9 days.....	26	Railroad traumatism.
Kallish, B. A.....	Panama Railroad Co.....	20 years.....	53	Softening of brain.
Mohen, Michael J.....	McClintic-Marshall Co.....	10 months...	27	Traumatism by fall.
Wood, Harold.....	Atlantic division.....	7 years.....	22	Traumatism by machines.
<i>February, 1913.</i>				
Catto, John F.....	Quartermaster's department.	7 years.....	40	Railroad traumatism.
Evans, Charles E.....	Fifth division.....	4 months.....	33	Septicemia.
Mulligan, T. J.....	McClintic-Marshall Co.....	3 months.....	26	Cerebral syphilis.
Stern, Harry.....	Commissary department.....		33	Homicide by firearms.
<i>March, 1913.</i>				
Mattimore, H. B.....	Mechanical division.....		49	Perforated gastric ulcer.
<i>April, 1913.</i>				
Devers, Hughes.....	McClintic-Marshall Co.....	5 months.....	24	Traumatism by fall.
Edwards, Harvey.....	do.....	14 months...	31	Do.
Johnson, Olaf W.....	Atlantic division.....	4 years.....	34	Infection of undetermined origin.
Modin, Harry.....	Dredging division.....	11 years.....	40	Organic disease of heart.
Swinhart, Charles.....	Central division.....	7 years.....	31	Traumatism by landslides.
Wallace, Ross S.....	McClintic-Marshall Co.....	11 years.....	44	Traumatism by fall.
<i>May, 1913.</i>				
Sinclair, Joseph M.....	Sanitary department.....	9 years.....	32	Organic disease of heart.
<i>June, 1913.</i>				
Allen, W. J.....	Atlantic division.....	6 years.....	52	Cerebral hemorrhage.
Myers, Thomas J.....	Fifth division.....	5½ years.....	53	Carcinomatosis.
Nicholson, John E.....	American Cement Tile Co.....	5 weeks.....	22	Malaria fever, E. A.
Stevenson, Olaf P.....	First division.....	8 months.....	35	Traumatism by machines.

*Deaths of white women and children from the United States.*

Name.	Time on Isthmus.	Age.	Cause of death.
<i>July, 1912.</i>			
Farley, Thelma.....	3 years.....	4 years....	Chronic nephritis.
Jerry, Carl Nelson, jr.....	3 days.....	3 days.....	Convulsions of infants.
Reidy, John Vaughn.....	7 weeks.....	7 weeks.....	Acute indigestion.
Rohden, Mrs. N.....	4 years.....	48 years....	Embolism.
Wilson, Pearl.....	1 year.....	26 years....	Acute enterocolitis.
<i>August, 1912.</i>			
Duvall, Fredericka.....	2 years.....	2 years.....	Cerebrospinal meningitis.
Kane, Mrs. Geo. N.....	6 months....	63 years....	Diabetes.
Shearer, Mrs. S. G.....	2 years.....	.....	Extra uterine pregnancy.
<i>September, 1912.</i>			
Abendroth (infant).....	2 days.....	2 days.....	Premature birth.
Allen, Margaret E.....	15 months....	3 years.....	Accidental drowning.
<i>October, 1912.</i>			
Clarke (infant).....	9 days.....	9 days.....	Premature birth.
<i>November, 1912.</i>			
Lohman, Mrs. Chas. F.....	3 years.....	36 years....	Chronic nephritis.
Willett (infant).....	5 hours.....	5 hours.....	Premature birth.
<i>February, 1913.</i>			
Anderson, Mrs. Norman C.....	3 years.....	26 years....	Eclampsia.
Lampson, Mrs. O. R.....	5 years.....	34 years....	Intestinal obstruction.
Wuelper, Josephene.....	6 years.....	29 years....	Disseminated tuberculosis.
<i>March, 1913.</i>			
Browning, Mrs. W. S.....	6 years.....	49 years....	Cerebral apoplexy.
Keenan (infant) No. 1.....	47 days.....	47 days....	Premature birth.
Keenan (infant) No. 2.....	49 days.....	49 days....	Do.
Kerr (infant).....	11 hours.....	11 hours....	Do.
<i>May, 1913.</i>			
Grout, Mary A.....	2 years.....	64 years....	Cancer of peritoneum, intestines, and rectum.
Hanson, Herbert.....	3 years.....	14 years....	Pott's disease.
<i>June, 1913.</i>			
Cameron, Mrs. John.....	6 months....	45 years....	Malaria fever, estivo-autumnal.
Hess (infant).....	8 days.....	8 days.....	Premature birth.
Watkins (infant).....	2 days.....	2 days.....	Do.

*Death rate among Americans on the Isthmus.*

	Number of deaths.	Annual average per 1,000.
Average number of white employees from the United States (6,504):		
Disease.....	20	3.07
Violence.....	15	2.31
All causes.....	35	5.38
Average number of white women and children from the United States (4,583):		
Disease.....	24	5.24
Violence.....	1	.22
All causes.....	25	5.46
Average number of white employees and their families from the United States (11,087):		
Disease.....	44	3.97
Violence.....	16	1.44
All causes.....	60	5.41
Total number of Americans on the Canal Zone (12,404): <sup>1</sup>		
Disease.....	44	3.55
Violence.....	23	1.85
All causes.....	67	5.40

<sup>1</sup> The figures representing the total number of Americans on the Canal Zone include employees and their families and the officers and men of the Tenth Infantry and Marines and their families.

*Causes and places of death of employees and civil population.*

Diseases.	Ancon Hospi- tal.	Colon Hospi- tal.	Pana- ma.	Colon.	Zone.	Total.
<i>General diseases.</i>						
Typhoid fever.....	4	1	3			8
Malaria.....		2	44	29	32	107
Malaria fever:						
Estivo-autumnal.....	17	8	28		16	69
Tertian.....	2					2
Undetermined.....					1	1
Clinical.....					6	6
Cachexia.....			1	1	1	3
Hemoglobinuric fever, malarial.....	6				1	7
Whooping cough.....			1			1
Diphtheria and croup.....	3	3	5			11
Influenza.....			1			1
Dysentery.....	1		19	2	5	27
Entamebic.....	6		1		1	8
Bacillary.....	2					2
Unclassified.....	3					3
Leprosy.....					2	2
Erysipelas.....	1		1			2
Chicken pox.....				1		1
Purulent infection and septicemia.....	2	1			1	4
Pyemia.....	11					11
Septicemia.....	3	4	13	2	2	24
Pyemia and septicemia, pneumococcic.....	6		1			7
Tetanus.....	3	4	17			24
Pellagra.....	5	5	9	1	1	21
Beriberi.....			15			15
Tuberculosis of the lungs.....	43	25	158	25	25	276
Acute miliary tuberculosis.....	15	3			2	20
Tuberculous meningitis.....	1	2	1	2	1	7
Abdominal tuberculosis.....	4	2	5			11
Pott's disease.....	1				1	2
Tuberculosis of the larynx.....			3			3
Tuberculous abscess.....				1		1
Disseminated tuberculosis.....	47	2	1	3		53
Rickets.....			2			2
Syphilis:						
Primary.....				1		1
Secondary.....			1			1
Tertiary.....	6	1			1	8
Hereditary.....		1	8	2	5	16
Period not stated.....		2	10			12
Gonorrheal arthritis.....			1			1
Gonorrheal orchitis and epididymitis.....			1	1		2
Cancer and other malignant tumors:						
Buccal cavity.....			1			1
Stomach and liver.....	5	1	1	1		8
Peritoneum, intestines, rectum.....		1			1	2
Female genital organs.....	2		5			7
Breast.....			2	1		3
Skin.....			1			1
Other organs and of organs not specified.....	4	1	8			13
Acute articular rheumatism.....			2			2
Diabetes.....		1	1			2
Hodgkin's disease.....					1	1
Anemia:						
Chlorosis.....	1		1		2	4
Primary, pernicious.....	2	1	1		1	5
Secondary, cause not determined.....	1		1		1	3
Alcoholism (acute or chronic).....	1		4			5
Acute.....	2	1	1			4
Chronic.....	1	1	1			3
Drug habit.....		1				1
<i>Diseases of the nervous system and of the organs of special sense.</i>						
Encephalitis.....	1				1	2
Simple meningitis.....	8	1	17		1	27
Cerebrospinal fever.....		2		1	1	4
Pneumococcus meningitis.....	5	2				7
Other diseases of the spinal cord.....	1	2	1	1		5
Acute anterior poliomyelitis.....				1		1
Cerebral hemorrhage, apoplexy.....	9	6	17	12	4	48
Softening of the brain.....	2	2				4
Paralysis without specified cause.....			4		1	5
General paralysis of the insane.....	1					1
Other forms of mental alienation.....	5	1				6
Epilepsy.....	1		3	2	1	7

## Causes and places of death of employees and civil population—Continued.

Diseases.	Ancon Hospital.	Colon Hospital.	Panama.	Colon.	Zone.	Total.
<i>Diseases of the nervous system and of the organs of special sense—Continued.</i>						
Convulsions:						
Nonpuerperal, 5 years and over.....			1		2	3
Infants, under 5 years of age.....			2	2	9	13
Neuritis.....			2			2
Other diseases of the nervous system.....	2					2
Tumor of the brain.....	1	1	3			5
Neurasthenia.....					1	1
<i>Diseases of the circulatory system.</i>						
Pericarditis.....					2	2
Acute endocarditis.....	3	3	25	4		35
Malignant endocarditis.....				1		1
Organic diseases of the heart.....	23	11	20	6	29	89
Angina pectoris.....			3	2		5
Diseases of the arteries, atheroma, aneurysm, etc.....				1		1
Aneurysm.....	8	1	1		1	11
Arteriosclerosis.....	2		7	1		10
Embolism and thrombosis.....	6		1			7
Diseases of the veins (varices, hemorrhoids, phlebitis, etc.).....			1			1
Diseases of the lymphatic system (lymphangitis, etc.).....			1			1
Lymphadenitis (nonvenereal).....			1			1
Hemorrhage; other diseases of the circulatory system.....		1	8		2	11
<i>Diseases of the respiratory system.</i>						
Diseases of the larynx.....	1				1	2
Laryngitis.....			2		2	4
Acute bronchitis.....	1		46	12	2	61
Chronic bronchitis.....			5			5
Broncho-pneumonia.....	7	8	28	21	24	88
Pneumonia (unqualified).....			70	8	7	85
Lobar pneumonia.....	57	16	12	2	9	96
Pleurisy.....			3	3		6
Empyema.....			4	1		5
Pulmonary congestion, pulmonary apoplexy.....		2	16		1	19
Gangrene of the lungs.....	7					7
Other diseases of the respiratory system (tuberculosis excepted).....	1				1	2
Abscess of lungs.....	1			1		2
<i>Diseases of the digestive system.</i>						
Diseases of the mouth and adnexa.....	1					1
Diseases of the teeth and gums.....			1			1
Stomatitis.....					2	2
Diseases of the pharynx.....	1					1
Stricture of the esophagus.....			1			1
Ulcer of the stomach.....		1		1		2
Other diseases of the stomach (cancer excepted).....			1			1
Acute gastritis.....				5		6
Acute indigestion.....		1		1	5	7
Diarrhea and enteritis (under 2 years).....	6	4	178	31	46	265
Colitis (under 2 years).....	3	4	13	2	6	28
Diarrhea and enteritis (2 years and over).....	1		20	2		23
Colitis (2 years and over).....	1	1	5			8
Ankylostomiasis.....	1	1			1	3
Intestinal parasites.....		1			1	1
Ascariasis.....	1				1	1
Bilharziosis, intestinal.....	1					1
Appendicitis and typhlitis.....	3					3
Acute appendicitis.....			2			2
Hernia, intestinal obstructions.....	1		2		1	4
Other hernias.....	1					1
Intestinal obstruction.....	2		5	1	3	11
Other diseases of the intestines.....		1				1
Duodenal ulcer.....	3			1	1	5
Cirrhosis of the liver.....	3	1	18	2	1	25
Biliary calculi.....	1			1		2
Other diseases of the liver.....	1		4			5
Abscess of liver (unqualified).....	1	1				2
Abscess of the liver, entamœbic.....	3	2				5
Cholecystitis.....				1		1
Abscess of spleen.....	1					1
Simple peritonitis (nonpuerperal).....	2	4	5		3	14
Other diseases of the digestive system (cancer and tuberculosis excepted).....					2	2

*Causes and places of death of employees and civil population—Continued.*

Diseases.	Ancon Hospi- tal.	Colon Hospi- tal.	Pana- ma.	Colon.	Zone.	Total.
<i>Nonvenereal diseases of the genito-urinary system and adnexa.</i>						
Acute nephritis.....	4	3	33	5	11	56
Bright's disease (chronic nephritis).....	31	30	53	13	11	138
Other diseases of the kidney and adnexa.....	6		1			7
Pyelonephrosis.....	1				1	2
Calculi of the urinary passages.....	1					1
Cystitis.....	1		1			2
Diseases of the urethra, urinary abscess, etc.....	1					1
Stricture of the urethra, nonvenereal.....	1					1
Vesico-vaginal fistula.....			1			1
Diseases of the prostate.....			1			1
Chronic prostatitis.....			1			1
Hydrocele.....			1			1
Uterine tumor (noncancerous).....				1		1
Salpingitis and other diseases of the female genital organs.....			3			3
<i>The puerperal state.</i>						
Accidents of pregnancy.....			1			1
Extra-uterine pregnancy.....	1					1
Hyperemesis gravidarum.....	1					1
Abortion.....			2			2
Puerperal hemorrhage.....		1			3	4
Puerperal septicemia.....	1	6	2	1	2	12
Puerperal albuminuria and convulsions.....				1		1
Eclampsia.....	4	3		3	5	15
Following childbirth (not otherwise defined).....		1			1	2
<i>Diseases of the skin and of the cellular tissue.</i>						
Gangrene.....			5			5
Furuncle.....			1			1
Carbuncle.....		1				1
Acute abscess.....			3			3
Phlegmon and cellulitis.....	1					1
Elephantiasis.....	1		1			2
Other diseases of the skin and annexa.....			1			1
<i>Diseases of the bones and of the organs of locomotion.</i>						
Diseases of the bones (tuberculosis excepted).....	1					1
<i>Malformations.</i>						
Congenital malformations (stillbirth not included).....	1		2		1	4
<i>Diseases of early infancy.</i>						
Newborn child.....					1	1
Congenital debility, icterus, and sclerema.....	10	1		8	13	32
Premature birth.....	5	10	10	11	16	52
Congenital debility.....	8	2	20	25	17	72
Malnutrition.....	1	6	39	18	114	178
Other causes peculiar to early infancy (including vari- ous consequences of labor).....	3		18	7	6	34
Lack of care.....			1	2	1	4
<i>Old age.</i>						
Senility.....	3		2	5	7	17
<i>Affections produced by external causes.</i>						
Suicide by poisoning.....	1		5	1		7
Suicide by hanging or strangulation.....					1	1
Suicide by drowning.....				1	1	2
Suicide by firearms.....		1	2		1	4
Other acute poisonings.....					2	2
Burns (conflagration excepted).....	6		2		2	10
Absorption of deleterious gases (conflagration excepted).....	2	1		2	2	5
Accidental drowning.....			4	6	30	40
Traumatism by firearms.....	1				1	2
Traumatism by cutting or piercing instruments.....			1			1
<i>Traumatism:</i>						
Fall.....	11	4	2	1	17	35
Mines and quarries.....					2	2
Machines.....	7	2			4	13
Other crushings (vehicles, railroads, landslides, etc.).....	5	1	3		5	14



*Causes and places of death of employees and civil population—Continued.*

Diseases.	Ancon Hospi- tal.	Colon Hospi- tal.	Pana- ma.	Colon.	Zone.	Total.
<i>Affections produced by external causes—Continued.</i>						
Railroad traumatism.....	15	7	.....	2	44	68
Dynamite traumatism.....	.....	.....	.....	.....	7	7
Traumatism by landslides.....	.....	.....	.....	.....	7	7
Injuries by animals.....	.....	.....	1	.....	.....	1
Electricity (lightning excepted).....	.....	.....	1	.....	3	4
Homicide by firearms.....	.....	1	6	1	2	10
Homicide by cutting or piercing instruments.....	2	1	1	1	1	6
Homicide by other means.....	.....	.....	.....	.....	1	1
Other external violence.....	2	2	.....	.....	5	9
<i>Ill-defined diseases.</i>						
Ill-defined organic diseases.....	2	1	.....	.....	2	5
Sudden death.....	.....	.....	3	.....	.....	3
Cause of death not specified or ill-defined.....	3	.....	17	1	3	24
Infections of undetermined origin.....	8	1	5	.....	4	16
Total.....	552	241	1, 192	315	644	2, 944
Stillbirths.....	1	21	129	62	107	320
Grand total.....	553	262	1, 321	377	751	3, 264

NOTE.—The deaths occurring in Ancon and Colon hospitals resulting from illness, injury, or other cases admitted from the cities of Panama and Colon, or from the Canal Zone, are in the table of vital statistics, credited to the places from whence they were admitted.

*Table showing discharges and deaths of employees in the hospitals of the Isthmian Canal Commission, from all causes, for the fiscal year 1912-13.*

Diseases.	Discharged.	Died.
<i>General diseases.</i>		
Typhoid fever.....	29	3
Malarial fever:		
Estivo-autumnal.....	3, 221	9
Tertian.....	787	.....
Quartan.....	72	.....
Mixed.....	4	.....
Undetermined.....	.....	.....
Clinical.....	1, 307	.....
Cachexia.....	67	.....
Hemoglobinuric fever, malarial.....	18	5
Vaccinia.....	19	.....
Measles.....	17	.....
Scarlet fever.....	7	.....
Diphtheria and croup.....	5	1
Influenza.....	331	.....
Dysentery.....	1	.....
Entamoebic.....	21	1
Bacillary.....	2	1
Unclassified.....	126	1
Leprosy.....	3	.....
Erysipelas.....	6	.....
Dengue.....	85	.....
Chicken pox.....	3	.....
Mumps.....	4	.....
Hemoglobinuric fever, unqualified.....	17	.....
Yaws.....	2	.....
Filariasis.....	13	.....
Acute infectious jaundice (Weil's disease).....	2	.....
Purulent infection and septicemia.....	37	2
Pyemia.....	1	4
Septicemia.....	.....	5
Pyemia and septicemia, pneumococcic.....	2	4
Tetanus.....	1	2
Mycoses.....	1	.....
Actinomycosis.....	1	.....
Pellagra.....	4	1
Tuberculosis of the lungs.....	134	27
Acute military tuberculosis.....	.....	7
Tuberculous meningitis.....	1	1
Abdominal tuberculosis.....	1	4
Pott's disease.....	1	1

Table showing discharges and deaths of employees in the hospitals of the Isthmian Canal Commission, from all causes, for the fiscal year 1912-13—Continued.

Diseases.	Discharged.	Died.
<i>General diseases—Continued.</i>		
Tuberculosis:		
Bones and joints.....	7	.....
Other organs.....	4	.....
Larynx.....	1	.....
Skin.....	1	.....
Lymph glands.....	10	.....
Genito-urinary organs.....	3	.....
Disseminated tuberculosis.....	2	25
Syphilis:		
Primary.....	34	.....
Secondary.....	155	.....
Tertiary.....	247	2
Period not stated.....	97	1
Gonococcus infection.....	28	.....
Gonorrhea.....	386	.....
Gonorrheal:		
Arthritis.....	56	.....
Bubo.....	24	.....
Orchitis and epididymitis.....	93	.....
Ophthalmia.....	7	.....
Soft chancre.....	413	.....
Adenitis chancroidal.....	159	.....
Cancer and other malignant tumors of the stomach and liver.....	2	2
Cancer and other malignant tumors of the peritoneum, intestines, rectum.....	3	.....
Cancer and other malignant tumors of the female genital organs.....	1	.....
Cancer and other malignant tumors:		
Breast.....	2	.....
Skin.....	3	.....
Other organs and of organs not specified.....	6	1
Other tumors (tumors of the female genital organs excepted).....	48	.....
Acute articular rheumatism.....	28	.....
Chronic rheumatism and gout.....	2	.....
Gout.....	1	.....
Arthritis deformans.....	1	.....
Diabetes.....	5	.....
Anemia, chlorosis.....	.....	1
Anemia secondary, cause not determined.....	21	.....
Other general diseases.....	12	.....
Alcoholism:		
Acute or chronic.....	12	1
Acute.....	66	2
Chronic.....	24	.....
Alcoholic psychosis.....	7	.....
Other chronic occupation poisonings.....	2	.....
Other chronic poisonings.....	1	.....
<i>Diseases of the nervous system, and of the organs of special sense.</i>		
Simple meningitis.....	1	5
Pneumococcus meningitis.....	.....	3
Locomotor ataxia.....	1	.....
Other diseases of the spinal cord.....	3	2
Cerebral hemorrhage, apoplexy.....	5	10
Softening of the brain.....	1	1
Paralysis without specified cause.....	9	.....
Other forms of mental alienation.....	35	1
Dementia precox.....	18	.....
Epilepsy.....	19	.....
Hysteria.....	13	.....
Neuralgia.....	24	.....
Neuritis.....	87	.....
Other diseases of the nervous system.....	6	1
Tumor of the brain.....	.....	1
Neurasthenia.....	183	.....
Diseases of the eyes and their annexa.....	513	.....
Follicular conjunctivitis.....	92	.....
Trachoma.....	2	.....
Diseases of the ears.....	219	.....
<i>Diseases of the circulatory system.</i>		
Pericarditis.....	8	.....
Acute endocarditis.....	1	.....
Organic diseases of the heart.....	91	12
Aneurysm.....	4	4
Arteriosclerosis.....	9	.....
Embolism and thrombosis.....	.....	1
Diseases of the veins (varices hemorrhoids, phlebitis, etc.).....	11	.....
Hemorrhoids.....	134	.....
Varices.....	15	.....
Varicocele.....	55	.....

Table showing discharges and deaths of employees in the hospitals of the Isthmian Canal Commission, from all causes, for the fiscal year 1912-13—Continued.

Diseases.	Discharged.	Died.
<i>Diseases of the circulatory system—Continued.</i>		
Phlebitis.....	7	—
Diseases of the lymphatic system (lymphangitis, etc.).....	17	—
Lymphadenitis (nonvenereal).....	199	—
Hemorrhage; other diseases of the circulatory system.....	12	—
<i>Diseases of the respiratory system.</i>		
Diseases of the nasal fossae.....	368	—
Adenoid vegetations.....	10	—
Myiasis of nasal fossae and sinuses.....	26	—
Diseases of the larynx.....	1	—
Laryngitis.....	12	—
Diseases of the thyroid body.....	5	—
Acute bronchitis.....	392	—
Chronic bronchitis.....	61	—
Broncho-pneumonia.....	16	—
Pneumonia (unqualified).....	1	—
Lobar pneumonia.....	188	54
Pleurisy.....	195	—
Empyema.....	5	—
Pulmonary congestion, pulmonary apoplexy.....	3	1
Gangrene of the lungs.....	—	3
Asthma.....	43	—
Pulmonary emphysema.....	9	—
Other diseases of the respiratory system (tuberculosis excepted).....	4	1
Abscess of lungs.....	2	1
Hay fever.....	1	—
<i>Diseases of the digestive system.</i>		
Diseases of the mouth and annexa.....	16	1
Diseases of the teeth and gums.....	21	—
Stomatitis.....	3	—
Diseases of the pharynx.....	95	1
Pharyngitis.....	60	—
Follicular tonsillitis.....	194	—
Diseases of the oesophagus.....	1	—
Ulcer of the stomach.....	18	1
Other diseases of the stomach (cancer excepted).....	91	—
Gastroectasis.....	5	—
Acute gastritis.....	47	—
Chronic gastritis.....	80	—
Acute indigestion.....	133	—
Diarrhea and enteritis (2 years and over).....	138	—
Colitis.....	15	1
Ankylostomiasis.....	59	—
Intestinal parasites.....	1	—
Ascariasis.....	1	—
Bilharziasis, intestinal.....	4	1
Taeniasis.....	6	—
Appendicitis and typhlitis.....	70	2
Acute appendicitis.....	73	—
Chronic appendicitis.....	52	—
Hernia, intestinal obstructions.....	1	1
Inguinal hernia.....	269	—
Other hernias.....	16	—
Other diseases of the intestines.....	50	1
Constipation.....	127	—
Duodenal ulcer.....	8	3
Hydatid tumor of the liver.....	1	—
Cirrhosis of the liver.....	10	1
Biliary calculi.....	7	2
Other diseases of the liver.....	23	—
Abscess of liver (unqualified).....	9	—
Abscess of the liver entamoebic.....	1	2
Cholecystitis.....	11	—
Diseases of the spleen.....	4	1
Abscess of spleen.....	2	—
Simple peritonitis (nonpuerperal).....	16	6
<i>Nonvenereal diseases of the genito-urinary system and annexa.</i>		
Acute nephritis.....	31	6
Bright's disease (chronic nephritis).....	68	21
Other diseases of the kidney and annexa.....	10	1
Pyelo-nephrosis.....	8	—
Calculi of the urinary passages.....	21	1
Diseases of the bladder.....	1	—
Cystitis.....	32	—

Table showing discharges and deaths of employees in the hospitals of the Isthmian Canal Commission, from all causes, for the fiscal year 1912-13—Continued.

Diseases.	Discharged.	Died.
<i>Nonvenereal diseases of the genito-urinary system and annexe—Continued.</i>		
Diseases of the urethra, urinary abscess, etc.	35	1
Stricture of the urethra, nonvenereal.	62	
Acute prostatitis.	4	
Chronic prostatitis.	2	
Hypertrophy of prostate.	2	
Nonvenereal diseases of the male genital organs.	91	
Hæmatocele.	1	
Hydrocele.	86	
Chylocele.	1	
Uterine hemorrhage (nonpuerperal).	1	
Uterine tumor (noncancerous).	6	
Other diseases of the uterus.	8	
Cysts and other tumors of the ovary.	3	
Salpingitis and other diseases of the female genital organs.	9	
<i>The puerperal state.</i>		
Normal labor.	2	
Accidents of pregnancy.	1	
Abortion.	3	
<i>Diseases of the skin and of the cellular tissue.</i>		
Gangrene.	1	
Furuncle.	95	
Carbuncle.	26	
Acute abscess.	286	
Phlegmon and cellulitis.	115	1
Trichophytosis.	3	
Scabies.	7	
Chiggers (Pulex penetrans).	3	
Red bug.	1	
Pemphigus contagiosus.	2	1
Elephantiasis.	1	
Dhobie itch.	56	
Ulcer of the skin.	127	
Oriental sore (Leishmaniasis).	7	
Impetigo contagiosa.	9	
Urticaria.	8	
Ingrowing nail.	30	
Other diseases of the skin and annexe.	165	
<i>Diseases of the bones and of the organs of locomotion.</i>		
Diseases of the bones (tuberculosis excepted).	34	
Caries (nontuberculous).	5	
Mastoid abscess.	2	
Osteomyelitis.	7	
Periostitis.	15	
Diseases of the joints (tuberculosis and rheumatism excepted).	10	
Ankylosis.	2	
Arthritis.	71	
Synovitis.	38	
Amputations.	58	
Other diseases of the organs of locomotion.	189	
<i>Malformations.</i>		
Congenital malformations (stillbirth not included).	5	
<i>Old age.</i>		
Senility.		2
<i>Affections produced by external causes.</i>		
Poisoning by food.	25	
Other acute poisonings.	5	
Venomous bites and stings.	1	
Snake bites.	1	
Burns (conflagration excepted).	168	2
Absorption of deleterious gases (conflagration excepted).		2
Traumatism:		
Firearms.	24	1
Cutting or piercing instruments.	680	1
Fall.	739	12
Mines and quarries.	173	
Machines.	360	4
Other crushings (vehicles, railroads, landslides, etc.).	230	1
Railroad traumatism.	280	13
Dynamite traumatism.	76	

Table showing discharges and deaths of employees in the hospitals of the Isthmian Canal Commission, from all causes, for the fiscal year 1912-13—Continued.

Diseases.	Discharged.	Died.
<i>Affections produced by external causes—Continued.</i>		
Traumatism by landslides.....	40	1
Injuries by animals.....	8	.....
Starvation.....	2	.....
Heat exhaustion.....	1	.....
Lightning.....	3	.....
Electricity (lightning excepted).....	5	.....
Fractures (cause not specified).....	520	.....
Dislocations.....	25	.....
Sprains.....	161	.....
Other external violence.....	2,634	9
<i>Ill-defined diseases.</i>		
Ill-defined organic disease.....	.....	1
Cause of death or disease not specified or ill-defined.....	2	1
Infections of undetermined origin.....	27	3
No disease.....	68	.....
Feigned disease.....	10	.....
Total.....	21,359	324

*Consolidated hospital report.*

Hospitals.	Remain- ing July 1.		Admitted.		Died.		Discharged.		Trans- ferred.		Remain- ing June 30.	
	White.	Colored.	White.	Colored.	White.	Colored.	White.	Colored.	White.	Colored.	White.	Colored.
Ancon Hospital:												
Employees.....	236	466	6,922	10,180	38	213	5,494	9,981	1,434	66	222	386
Nonemployees.....	106	89	2,886	1,844	45	210	2,657	1,584	160	39	130	100
Insane.....	25	261	31	182	2	44	19	78	4	26	31	295
Total.....	397	816	9,839	12,206	85	467	8,170	11,643	1,598	131	383	781
Colon Hospital:												
Employees.....	93	79	2,850	1,531	18	49	2,382	1,492	489	3	63	66
Nonemployees.....	45	71	1,407	1,770	21	153	1,370	1,581	19	16	42	91
Total.....	138	150	4,266	3,301	39	202	3,752	3,073	508	19	105	157
Culebra Hospital: Nonemployees.....	.....	6	21	102	.....	6	19	86	2	16	.....	.....
Palo Seco Leper Asylum:												
Employees.....	.....	1	.....	1	.....	.....	.....	2	.....	.....	.....	.....
Nonemployees.....	2	47	1	12	.....	8	.....	6	.....	2	3	43
Total.....	2	48	1	13	.....	8	.....	8	.....	2	3	43
Taboga Sanitarium:												
Employees.....	41	.....	1,953	.....	.....	.....	1,938	.....	23	.....	33	.....
Nonemployees.....	18	.....	1,189	.....	.....	.....	1,193	.....	1	.....	13	.....
Total.....	59	.....	3,142	.....	.....	.....	3,131	.....	24	.....	46	.....
Grand totals:												
Employees.....	400	546	11,734	11,712	56	262	9,814	11,475	1,946	69	318	452
Nonemployees.....	171	213	5,504	3,728	66	377	5,239	3,257	182	73	188	234
Insane.....	25	261	31	182	2	44	19	78	4	26	31	295
Total.....	596	1,020	17,269	15,622	124	683	15,072	14,810	2,132	168	537	981

*Consolidated sick camp report.*

Stations.	Remain- ing July 1.		Admitted.		Died.		Discharged.		Trans- ferred.		Remain- ing June 30.	
	White.	Colored.	White.	Colored.	White.	Colored.	White.	Colored.	White.	Colored.	White.	Colored.
Miraflores.....	4	2	265	358	.....	.....	123	227	146	133	.....	.....
Pedro Miguel.....	2	1	110	209	.....	.....	57	94	55	116	.....	.....
Paraiso.....	1	4	67	228	.....	.....	31	98	37	134	.....	.....
Culebra.....	2	6	364	515	2	1	260	373	104	147	.....	.....
Empire.....	1	4	129	445	.....	.....	104	342	26	107	.....	.....
Las Cascadas.....	3	1	70	181	.....	.....	59	169	14	13	.....	.....
Bas Obispo.....	.....	4	46	125	.....	.....	39	109	6	10	1	10
Gorgona.....	.....	8	30	364	.....	1	26	308	4	63	.....	.....
Gatun.....	5	14	401	988	.....	.....	206	620	200	382	.....	.....
Cristobal.....	.....	8	42	432	.....	.....	25	251	17	189	.....	.....
Porto Bello.....	.....	2	143	398	1	1	114	352	27	45	1	2
Toro Point.....	.....	.....	87	246	1	.....	25	90	62	155	.....	1
Total.....	18	54	1,754	4,489	3	3	1,069	3,033	698	1,494	2	13

*Consolidated report of employees sick in quarters.*

Stations.	Days excused for quarters.			New patients excused for quarters.		
	White.	Colored.	Total.	White.	Colored.	Total.
Naos Island.....	106	411	517	45	187	232
Ancon.....	1,366	515	1,881	551	80	631
Balboa.....	701	40	741	326	27	353
Corozal.....	787	.....	787	506	.....	506
Miraflores.....	106	21	127	81	19	100
Pedro Miguel.....	506	6	512	300	2	302
Paraiso.....	393	3	396	199	1	200
Culebra.....	606	217	823	293	88	381
Empire.....	1,671	17	1,688	771	6	777
Las Cascadas.....	635	7	642	275	2	277
Bas Obispo.....	172	22	194	87	7	94
Gorgona.....	3,809	2,245	6,054	1,658	785	2,443
Gatun.....	1,433	50	1,483	777	4	781
Cristobal.....	2,315	42	2,357	1,088	13	1,101
Porto Bello.....	176	.....	176	87	.....	87
Toro Point.....	44	.....	44	32	.....	32
Total.....	14,826	3,596	18,422	7,076	1,221	8,297

*Consolidated hospital, sick camp, and sick-in-quarters report.*

	Remain- ing July 1.		Admittca.		Died.		Discharged.		Trans- ferred.		Re- main- ing June 30.	
	White.	Colored.	White.	Colored.	White.	Colored.	White.	Colored.	White.	Colored.	White.	Colored.
Hospitals.....	596	1,020	17,269	15,622	124	683	15,072	14,810	2,132	168	537	981
Sick camps.....	18	54	1,754	4,489	3	3	1,069	3,033	698	1,494	2	13
Total.....	614	1,074	19,023	20,111	127	686	16,141	17,843	2,830	1,662	539	994

*Consolidated hospital, sick camp, and sick-in-quarters report—Continued.*

	White.	Colored.	Total.
Total admissions to hospitals and sick camps.....	19,023	20,111	39,134
Number of employees sick in quarters.....	7,076	1,221	8,297
Total.....	26,099	21,332	47,431
Less number of patients transferred from sick camps to hospitals, and hospitals to sanitarium, whose admissions are duplicated in above figures.	2,830	1,662	4,492
Net admissions to hospitals and sick camps, and those sick in quarters	23,269	19,670	42,939

*Consolidated dispensary report.*

Stations.	Employees.			Nonemployees.			Total.		
	White.	Colored.	Total.	White.	Colored.	Total.	White.	Colored.	Total.
Naos Island.....	1,491	9,727	11,218	.....	6	6	1,491	9,733	11,224
Ancon.....	7,801	20,102	27,903	4,140	4,784	8,924	11,941	24,886	36,827
Balboa.....	21,548	27,933	49,481	1,160	575	1,735	22,708	28,508	51,216
Corozal.....	16,472	13,795	30,267	4,389	2,001	6,390	20,861	15,796	36,657
Miraflores.....	23,014	32,367	55,381	630	599	1,229	23,644	32,966	56,610
Pedro Miguel.....	18,267	17,013	35,280	2,580	2,004	4,584	20,847	19,017	39,864
Paraiso.....	6,648	5,046	11,694	2,931	1,825	4,756	9,579	6,871	16,450
Culebra.....	16,110	17,216	33,326	5,674	6,463	12,137	21,784	23,679	45,463
Empire.....	14,316	24,687	39,003	7,891	5,503	13,394	22,207	30,190	52,397
Las Cascadas.....	5,459	5,261	10,720	4,792	3,368	8,160	10,251	8,629	18,880
Bas Obispo.....	9,179	12,485	21,664	2,989	3,362	6,351	12,168	15,847	28,015
Gorgona.....	19,837	19,556	39,393	6,858	6,423	13,281	26,695	25,979	52,674
Gatun.....	31,578	38,334	69,912	5,473	5,164	10,637	37,051	43,498	80,549
Cristobal.....	12,658	17,353	30,011	5,820	3,501	9,321	18,478	20,854	39,332
Porto Bello.....	4,357	7,396	11,753	966	1,184	2,150	5,323	8,507	13,903
Toro Point.....	3,671	7,976	11,647	981	531	1,512	4,652	8,580	13,159
Margarita Point.....	1,299	3,520	4,819	.....	.....	.....	1,299	3,520	4,819
Total.....	213,705	279,767	493,472	57,274	47,293	104,567	270,979	327,060	598,039

*Average number of employees constantly sick in hospitals, sick camps, and quarters.*

Hospitals.	White.	Colored.	Total.
Ancon Hospital.....	239.33	472.33	711.66
Colon Hospital.....	101.00	80.02	181.02
Palo Seco Leper Asylum.....	.....	.46	.46
Taboga Sanitarium.....	36.06	.....	36.06
Total.....	376.39	552.81	929.20

Stations.	Sick camps.			Sick in quarters.		
	White.	Colored.	Total.	White.	Colored.	Total.
Naos Island.....	.....	.....	.....	0.29	1.13	1.42
Ancon.....	.....	.....	.....	3.74	1.41	5.15
Balboa.....	.....	.....	.....	1.92	.11	2.03
Corozal.....	.....	.....	.....	2.16	.....	2.16
Miraflores.....	1.42	1.73	3.15	.29	.06	.35
Pedro Miguel.....	.66	1.10	1.76	1.38	.02	1.40
Paraiso.....	.44	1.38	1.82	1.08	.01	1.09
Culebra.....	3.25	4.68	7.93	1.66	.59	2.25
Empire.....	1.01	2.95	3.96	4.58	.05	4.63
Las Cascadas.....	.98	2.84	3.82	1.74	.02	1.76
Bas Obispo.....	.62	2.40	3.02	.47	.06	.53
Gorgona.....	.28	3.84	4.12	10.43	6.15	16.58
Gatun.....	2.37	6.81	9.18	3.92	.14	4.06
Cristobal.....	.24	2.21	2.45	6.34	.12	6.46
Porto Bello.....	1.52	4.34	5.86	.48	.....	.48
Toro Point.....	.33	1.04	1.37	.12	.....	.12
Total.....	13.12	35.32	48.44	40.60	9.87	50.47

*Average number of employees constantly sick.*

	White.	Colored.	Total.
Hospitals.....	376.39	552.81	929.20
Sick camps.....	13.12	35.32	48.44
Sick in quarters.....	40.60	9.87	50.47
Total.....	430.11	598.00	1,028.11

*Average number of employees constantly sick per 1,000.*

	White.	Colored.	Total.
Hospitals.....	29.87	13.35	17.21
Sick camps.....	1.04	.85	.90
Sick in quarters.....	3.22	.24	.93
Total.....	34.13	14.44	19.04

*Average number of days' treatment per employee in hospitals, sick camps, and quarters.*

Hospitals.	White.	Colored.	Total.
Ancon Hospital.....	12.54	16.80	15.08
Colon Hospital.....	12.76	18.92	14.91
Palo Seco Leper Asylum.....	.....	84.50	84.50
Taboga Sanitarium.....	6.71	.....	6.71
Total.....	11.63	17.09	14.36

Stations.	Sick camps.			Quarters.		
	White.	Colored.	Total.	White.	Colored.	Total.
Naos Island.....	.....	.....	.....	2.37	2.19	2.23
Ancon.....	.....	.....	.....	2.48	6.44	2.98
Balboa.....	.....	.....	.....	2.15	1.48	2.10
Corozal.....	.....	.....	.....	1.56	.....	1.56
Miraflores.....	1.93	1.75	1.83	1.31	1.11	1.27
Pedro Miguel.....	2.15	1.92	2.00	1.68	3.00	1.69
Paraíso.....	2.37	2.17	2.21	1.97	3.00	1.98
Culebra.....	3.25	3.28	3.26	2.07	2.47	2.16
Empire.....	2.83	2.40	2.50	2.17	2.83	2.17
Las Cascadas.....	4.89	5.70	5.47	2.31	3.50	2.32
Bas Obispo.....	5.00	7.38	6.71	1.98	3.14	2.06
Gorgona.....	3.43	3.76	3.74	2.30	2.86	2.48
Gatun.....	2.13	2.48	2.38	1.84	12.50	1.90
Cristobal.....	2.12	1.83	1.86	2.10	3.23	2.17
Porto Bello.....	3.89	3.98	3.96	2.02	.....	2.02
Toro Point.....	1.40	1.54	1.51	1.38	.....	1.38
Total.....	2.71	2.85	2.81	2.10	2.95	2.22

*Subsistence and operating expenses.*

	Hospitals.	Sick camps.	Total.
SUBSISTENCE EXPENSES.			
Number of days' rations issued to patients.....	579,022	17,683	596,705
Cost of rations issued to patients.....	\$142,654.48	\$4,275.82	\$146,930.30
Cost of subsistence per patient per day.....	\$0.246	\$0.241	\$0.246
OPERATING EXPENSES.			
Number of days' relief furnished patients.....	579,022	17,683	596,705
Cost of operation.....	\$713,322.88	\$9,455.95	\$722,778.83
Cost per capita per day.....	\$1.23	\$0.53	\$1.21
Cost of operation with amount received from outside patients, etc., deducted.....	\$541,226.24	\$9,455.95	\$550,682.19
Cost per capita per day with above deduction.....	\$0.93	\$0.53	\$0.92
Cost of dispensaries.....	\$138,636.59	.....	.....



*Outside patients treated in hospitals, and amounts collected for their treatment.*

	Number of cases treated.	Number of days' relief.	Amount.
Patients for whom the Republic of Panama pays 75 cents per day ..	2, 557	72, 174	\$54, 130. 50
Patients for whom the Canal Zone Government pays 30 cents per day.....	271	6, 773	2, 031. 90
Patients paying 30 cents per day for themselves.....	3, 641	35, 535	10, 660. 50
Patients from the Republic of Panama paying other prices.....	1, 945	19, 007	53, 945. 61
Patients from the Canal Zone paying other prices.....	4, 857	36, 260	41, 252. 68
Patients from the Canal Zone not paying.....	2, 922	52, 945	.....
Patients from the Republic of Panama not paying.....	606	7, 399	.....
Total.....	16, 799	230, 093	162, 021. 19

NOTE.—Patients carried from one month to another are considered as separate cases in above table.

*Surgical operations performed in hospitals.*

	Number.	Died.		Number.	Died.
<b>Amputations:</b>			<b>Genitourinary tract—Contd.</b>		
Shoulder.....	2	1	Curetage uteri.....	196	.....
Arm.....	8	.....	Perineoplasty.....	49	.....
Forearm.....	5	1	Trachelorrhaphy.....	28	.....
Hip joint.....	1	1	Vaginal sections.....	34	.....
Thigh.....	5	.....	Vaginal punctures.....	5	.....
Leg.....	14	1	<b>Obstetrical:</b>		
Foot.....	7	.....	Caesarian section, abdominal.....	8	.....
Digits, multiple.....	35	.....	Caesarian section, vaginal.....	1	.....
Leg, double.....	2	1	High forceps.....	4	.....
<b>Operations on bones:</b>			Low forceps.....	19	.....
Cranioectomy—			Version.....	9	.....
Decompressive.....	20	7	Perineorrhaphy.....	85	.....
Exploratory.....	1	.....	<b>Thorax:</b>		
Laminectomy.....	8	6	Thoracotomy.....	12	2
Osteotomy.....	32	.....	Thoracoplasty.....	2	.....
Resection of elbow.....	1	.....	Pneumothoracotomy.....	1	1
Wiring of fractures—			Pericardiectomy.....	1	.....
Simple.....	62	2	Excision of breast and axilla.....	1	.....
Compound.....	27	1	<b>Rectum:</b>		
<b>Adenectomy:</b>			Hemorrhoids, radical cure.....	163	.....
Cervical.....	23	1	Fistula in anus, excision of.....	13	.....
Axillary.....	17	.....	Prolapsus rectum, radical excision.....	2	.....
Inguinal—			<b>General:</b>		
Single.....	460	.....	Thyroidectomy.....	10	.....
Double.....	123	.....	Aneurismorrhaphy.....	1	.....
Femoral.....	27	.....	Varicose veins, excision of.....	37	.....
<b>Herniotomy:</b>			Tenorrhaphy.....	11	.....
Inguinal—			Excision of surface neoplasms.....	53	.....
Single.....	214	1	Gunshot wound of soft parts, operation for.....	3	.....
Double.....	106	1	Extensive injuries to soft parts, operation for.....	1	1
Femoral.....	6	.....	Plastic operation for—		
Ventral.....	21	.....	Congenital defect.....	4	.....
Combined (any two of the above).....	5	.....	Severe injuries.....	50	1
Strangulated.....	5	2	Effects of disease.....	35	1
<b>Genitourinary tract:</b>			Skin graft.....	24	.....
Nephrotomy.....	3	.....	<b>Laparotomy:</b>		
Nephrectomy.....	4	.....	For general peritonitis.....	5	3
Nephropexy.....	1	.....	For tuberculous peritonitis.....	6	3
Perinephritic abscess, drainage of.....	2	.....	For intestinal obstruction.....	10	1
Ureterotomy.....	2	.....	Exploratory.....	29	2
Cystotomy.....	6	.....	Gastrostomy.....	2	.....
Urethrotomy—			Gastroenterostomy.....	10	1
Internal.....	40	1	Enterostomy.....	3	.....
External.....	53	.....	Enterectomy.....	2	.....
Prostatectomy.....	3	.....	Enterorrhaphy.....	2	.....
Varicocele, radical cure.....	36	.....	Appendectomy.....	243	.....
<b>Hydrocele—</b>			Appendectomy—		
Single, radical cure.....	82	.....	With local peritonitis.....	19	.....
Double, radical cure.....	15	.....	With general peritonitis.....	12	6
Orchidectomy.....	16	.....	Colostomy.....	3	1
Epididymotomy.....	112	.....	Sigmoidopexy.....	1	.....
<b>Amputation—</b>			Resection of rectum.....	1	.....
Scrotum.....	23	.....			
Penis.....	4	.....			
Penis and scrotum.....	6	.....			

*Surgical operations performed in hospitals—Continued.*

	Number.	Died.		Number.	Died.
<b>Laparotomy—Continued.</b>			<b>Laparotomy—Continued.</b>		
Cholecystotomy.....	3	.....	Oophorectomy.....	3	.....
Cholecystostomy.....	13	1	Suspensio-uteri.....	64	1
Cholecystectomy.....	2	.....	Plastic operation for chronic pelvic peritonitis.....	93	.....
Abscess of liver.....			For ectopic gestation.....	8	1
Laparohepatotomy for.....	14	3	For trauma:		
Thoracohepatotomy for.....	4	1	General peritonitis.....	1	.....
Splenectomy.....	3	1	Hemato-peritoneum.....	4	1
Panhysterectomy.....	23	.....	Rupture of liver.....	2	1
Supravaginal hysterectomy.....	21	.....	Rupture of spleen.....	1	1
Hysteromyomectomy.....	46	1	Gunshot wound of abdomen.....	1	.....
Myomectomy.....	9	.....	Stab wound of abdomen.....	3	2
Salpingectomy—			Major operations, various other.....	125	1
Single.....	22	.....	Minor operations, various.....	3,591	2
Double.....	34	.....			
Salpingo-oophorectomy.....	21	.....			
Ovarian cystectomy.....	6	1	<b>Total.....</b>	<b>6,972</b>	<b>68</b>

*Operations and work performed in eye, ear, nose, and throat clinics.*

Operations.	Number.	Operations.	Number.
Abscess, parotid.....	1	Plastic:	
Adenectomy.....	264	On ear.....	1
Advancement of external rectus.....	5	On eyeball.....	4
Advancement of internal rectus.....	3	On eyelid.....	9
Bowman's dilatation of lacrimal duct.....	2	Face.....	3
Capsulectomy.....	8	On lip.....	1
Cataract:		On mouth.....	1
Discission of.....	2	On nose.....	30
Needling.....	1	Pterygium:	
Conjunctival cyst.....	1	Ablation.....	10
Conjunctiva, papilloma.....	1	Transplantation.....	107
Cyst, sebaceous, excision.....	5	Reconstruction of nose.....	1
Dacryocystotomy.....	1	Removal of:	
Discission, juvenile cataract.....	1	Aural polyp.....	3
Excision, melano-sarcoma.....	1	Cyst, ear.....	1
Enucleation.....	17	Nasal polyp.....	21
Evisceration.....	5	Nasal spur.....	7
Excision of chalazion.....	19	Sclerotomy, posterior.....	5
Excision of cyst, iris.....	1	Septal spurs.....	9
Expression for eyelid.....	2	Sequestrum, removal, lachrymal.....	1
Expression for follicular conjunctivitis.....	6	Sinusotomy:	
Expression for trachoma.....	2	Maxillary radical.....	15
Extraction of cataract.....	29	Nasal.....	1
Holsrath-Kuhnt operation.....	2	Submucous resection of nasal septum.....	287
Incision of chalazion.....	12	Subperiosteal abscess.....	2
Incision of peritonsillar abscess.....	1	Synechia anterior, needling.....	1
Inferior turbinate, cauterizations.....	5	Tarsal tumors.....	11
Iridectomy.....	46	Tenotomy.....	8
Iridotomy.....	1	Tonsillectomy.....	474
Killian's operation—frontal sinus.....	2	Tonsillotomy.....	1
Lachrymal canaliculus incised.....	3	Tracheotomy.....	3
Lachrymal duct probed.....	23	Tucking:	
La Grange operation.....	1	External rectus.....	1
Lingual tonsil, cauterizations.....	15	Internal rectus.....	1
Mastoidectomy.....	18	Turbinectomy.....	131
Mastoidotomy:		Uvulotomy.....	4
Simple.....	5	Wolf's graft, eye.....	1
Radical.....	3	Vairous minor operations.....	1,056
Maxillary sinus.....	1		
Nasal bones, setting of.....	2	<b>Total.....</b>	<b>2,745</b>
Paracentesis:		Refractions.....	2,987
Cornea.....	5	Outside cases treated.....	16,924
Membrana tympani.....	10		
Polyctenule, excision.....	2	<b>Grand total.....</b>	<b>22,656</b>

## Consolidated ward laboratory report of all hospitals.

	Number.		Number.
Blood examinations.....	18,034	Stool examinations—Continued.	
Estivo-autumnal.....	4,177	Bismuth crystals.....	10
Tertian—		Ankylostoma worms.....	10
Single.....	1,262	Treponema pertenue.....	1
Double.....	1	Urine examinations.....	33,600
Mixed tertian and estivo-autumnal..	30	Albumen.....	7,834
Quartan.....	123	Albumen and casts.....	4,925
Differential blood counts.....	1,483	Sugar.....	97
Leucocyte counts.....	2,134	Pus and blood.....	3,102
Red blood counts.....	252	Gonococci.....	6
White blood counts.....	374	Indican.....	4
Hemoglobin estimations.....	742	Epithelium.....	531
Filaria.....	12	Bile.....	13
Guaiac and turpentine tests for in-		Microscopical examinations.....	733
visible blood.....	29	Trichomonas vaginalis.....	3
More test.....	1	Flagellated monads.....	3
Stool examinations.....	16,584	Hemin crystals.....	32
Ascaris lumbricoides.....	1,099	Guaiac and turpentine tests for blood	170
Uncinaria ova.....	2,862	Red blood cells.....	34
Uncinaria worms.....	10	Ciliated monads.....	1
Tricocephalus dispar.....	2,183	Bacilli, acid fast.....	1
Strongyloides intestinalis.....	793	Mucus.....	1
Tenia saginata.....	13	Chyluria.....	1
Ameba.....	72	Urea estimations.....	13
Mucus.....	6	Sputum examinations.....	2,102
Entameba.....	46	Tubercle bacilli.....	383
Ciliated monads.....	354	Streptococci.....	1
Bilharzia.....	76	Elastic tissue.....	2
Pus and blood.....	2,799	Pus.....	5
Pus and epithelial cells.....	12	Miscellaneous:	
Balantidium coli.....	12	Examinations of pleural effusions.....	5
Tubercle bacilli.....	5	Examinations of various smears and	
Entameba, tetragena.....	42	discharges.....	319
Oxyuris vermicularis.....	16	Examinations of spinal fluid.....	20
Entameba, histolytica.....	19	Examinations of vaginal and ureth-	
Entameba coli.....	39	ral discharges.....	170
Guaiac and turpentine tests for oc-		Gastric analyses.....	88
cult blood.....	39		

## Ancon Hospital.

Class.	Re- main- ing July 1.		Admitted.		Died.		Discharged.		Trans- ferred.		Re- main- ing June 30.	
	White.	Colored.	White.	Colored.	White.	Colored.	White.	Colored.	White.	Colored.	White.	Colored.
Isthmian Canal Commission em- ployees.....	245	377	6,714	8,933	37	167	5,323	8,738	1,387	59	212	346
Panama Railroad employees.....	21	89	208	1,247	1	46	171	1,243	47	7	10	40
Pay patients.....	93	65	2,589	1,281	36	103	2,373	1,152	156	19	117	72
Charity patients.....	13	24	297	563	9	107	284	432	4	20	13	28
Insane patients.....	25	261	31	182	2	44	19	78	4	26	31	295
Total.....	397	816	9,839	12,206	85	467	8,170	11,643	1,598	131	383	781
							White.	Colored.	Total.			
Average number of days' treatment per employee for the year.....							12.54	16.80	15.08			
Average number of employees constantly sick during the year.....							239.33	472.33	711.66			
Number of days' relief furnished patients.....									428,658			

Cost of subsistence per patient per day, \$0.210.

*Ancon Hospital—Continued.*

## NATIONALITY.

Class.	Number treated.	Americans.		Other nations.	
		White.	Colored.	White.	Colored.
Isthmian Canal Commission employees.....	16,269	2,743	19	3,863	9,644
Panama Railroad employees.....	1,565	155	1	84	1,325
Pay patients.....	4,028	1,715	2	907	1,404
Charity patients.....	897	189	1	108	599
Insane patients.....	499	13	.....	31	455
Total.....	23,258	4,815	23	4,993	13,427

*Operations.*—See report of all surgical operations.*Laboratory report.*—See consolidated ward laboratory report.*Colon Hospital.*

Class.	Remain- ing July 1.		Admitted.		Died.		Discharged.		Trans- ferred.		Remaining June 30.	
	White.	Colored.	White.	Colored.	White.	Colored.	White.	Colored.	White.	Colored.	White.	Colored.
Isthmian Canal Commission employees.....	78	55	2,377	833	13	21	2,009	832	387	1	46	34
Panama Railroad employees.....	15	24	482	698	5	28	373	660	102	2	17	32
Private pay.....	27	36	1,210	1,268	8	81	1,178	1,159	17	5	34	59
Municipal pay.....	3	6	18	112	5	14	15	92	1	.....	.....	12
Zone charity.....	15	29	179	390	8	58	177	330	1	11	8	20
Total.....	138	150	4,266	3,301	39	202	3,752	3,073	508	19	105	157

	White.	Colored.	Total.
Average number of days' treatment per employee for the year.....	12.76	18.92	14.91
Average number of employees constantly sick during the year.....	101.00	80.02	181.02
Number of days' relief furnished patients.....	.....	.....	110,420

Cost of subsistence per patient per day, \$0.286.

## NATIONALITY.

Class.	Number treated.	Americans.		Other nations.	
		White.	Colored.	White.	Colored.
Isthmian Canal Commission employees.....	3,343	1,835	.....	557	951
Panama Railroad employees.....	1,219	316	.....	134	769
Private pay.....	2,541	842	.....	373	1,326
Municipal pay.....	139	2	.....	17	120
Zone charity.....	613	110	.....	60	443
Total.....	7,855	3,105	.....	1,141	3,609

*Operations.*—See report of all surgical operations.*Laboratory report.*—See consolidated ward laboratory report.

*Culebra Hospital.*

Class.	Remain- ing July 1.		Admitted.		Died.		Dis- charged.		Trans- ferred.		Remain- ing June 30.	
	White.	Colored.	White.	Colored.	White.	Colored.	White.	Colored.	White.	Colored.	White.	Colored.
Nonemployees.....	....	6	21	102	....	6	19	86	2	16	....	0

Number of days' relief furnished patients, 1,123.

Cost of subsistence per patient per day, \$0.239.

## NATIONALITY.

Class.	Number treated.	Americans.		Other nations.	
		White.	Colored.	White.	Colored.
Nonemployees.....	129	6	1	14	108

*Operations.*—See report of all surgical operations.*Laboratory report.*—See consolidated ward laboratory report.*Palo Seco leper asylum.*

Class.	Re- main- ing July 1.		Ad- mitted.		Died.		Dis- charged.		Trans- ferred.		Re- main- ing, June 30.	
	White.	Colored.	White.	Colored.	White.	Colored.	White.	Colored.	White.	Colored.	White.	Colored.
Employees.....	1	1	1	1	1	1	2	2	1	1	1	1
Pay patients.....	1	28	1	9	3	3	3	3	1	1	2	30
Charity patients.....	1	19	3	3	5	3	3	3	1	1	1	13
Total.....	2	48	1	13	8	8	8	8	2	3	4	43

	White.	Colored.	Total.
Average number of days' treatment per employee for the year.....		84.50	84.50
Average number of employees constantly sick during the year.....		.46	.46
Number of days' relief furnished patients.....			17,656

Cost of subsistence per patient per day, \$0.307.

## NATIONALITY.

Class.	Number treated.	Americans.		Other nations.	
		White.	Colored.	White.	Colored.
Employees.....	2				2
Pay patients.....	39			2	37
Charity patients.....	23			1	22
Total.....	64			3	61

*Taboga Sanitarium.*

Class.	Remain- ing July 1.	Ad- mitted.	Died.	Dis- charged.	Trans- ferred.	Remain- ing June 30.
Employees.....	41	1,953	.....	1,938	23	33
Families of employees.....	18	1,189	.....	1,193	1	13
Total.....	59	3,142	.....	3,131	24	46

Average number of days' treatment per employee for the year .....	6.71
Average number of employees constantly sick during the year.....	36.06
Number of days' relief furnished patients .....	21,165
Cost of subsistence per patient per day .....	\$0.674

## NATIONALITY.

Class.	Number treated.	Americans.	Other nations.
Employees.....	1,994	1,420	574
Families of employees.....	1,207	1,166	41
Total.....	3,201	2,586	615

NOTE.—No colored patients treated at Taboga Sanitarium.

*Santo Tomas Hospital.*

Class.	Remain- ing July 1.	Admit- ted.	Died.	Dis- charged.	Trans- ferred.	Remain- ing June 30.
Pay cases .....	30	1,090	21	1,052	.....	47
Charity cases .....	212	5,662	381	5,232	.....	261
Total.....	242	6,752	402	6,284	.....	308

Average number of days' treatment per patient .....	15.92
Average number of patients constantly sick .....	291.59
Number of days' relief furnished patients .....	106,430
Cost of subsistence per patient per day .....	\$0.250

## NATIONALITY.

Class.	Number treated.	Americans.		Other nations.	
		White.	Colored.	White.	Colored.
Pay cases.....	1,120	.....	.....	329	781
Charity cases.....	5,874	.....	.....	716	5,158
Total.....	6,994	.....	.....	1,055	5,939

## OPERATIONS.

	Number.	Died.
Major.....	817	26
Minor.....	159	.....
Total.....	976	26

*Santo Tomas Hospital—Continued.*

## DISPENSARY.

Class.	White.	Colored.	Total.
Natives.....	2,181	2,777	4,958
Foreigners.....	436	871	1,307
Total.....	2,617	3,648	6,265

*Board of health laboratory.*

## Bacteriological examinations:

Water.....	1
Milk.....	1
Cultures, various.....	5
Larvacide test.....	1
Fluids and exudates.....	4
Fluid from tumor.....	1
Blood cultures.....	328
Throat cultures (diphtheria suspects).....	648
Cultures from autopsies.....	50
Cultures from eye.....	5
Stools.....	270
Urine.....	432
Sputum.....	20
Pus.....	16
Hydrocele fluid.....	4
Knee-joint fluid.....	14
Fluid from cyst.....	1
Spinal fluid.....	54
Various smears and specimens.....	99
Pleural fluid.....	7
Cultures from frontal sinuses.....	3
Scrapings.....	1
Tonsils.....	1
Fluid from sinus in kidney.....	1
"Powdelac".....	1
Fluid from joint.....	1
Fluid from chest.....	2
Animal.....	2
Scrapings from left femur.....	1
Aspirated fluid.....	1
Abdominal fluid.....	1
Fluid from hematoma.....	1
Peritoneal fluid.....	1
Fluid from pleural cavity.....	3
Fluid from gall bladder.....	1
Determinations:	
Larvacidal value of commercial disinfectant.....	2
Quinine in ampules of quinine hydrochloride.....	1
Examinations:	
Leper suspects.....	14
Rabies suspects.....	3
Animals.....	26
Chemical examinations:	
Preparations made.....	2
Brackish water.....	14
Kidney stone.....	1
Gall stones.....	1

## Chemical examinations—Continued.

Pyrodresol.....	1
Knife for police department.....	1
Coal.....	1
Rosin.....	1
Blood.....	1
Stomach contents.....	7
Bismuth subnitrate.....	1
Urine.....	36
Crude carbolic acid.....	1
Various liquids, fluids, etc.....	42
Various metals.....	3
Sugar cane.....	3
Oil, vaseline.....	2
Coke.....	1
Sugar, brown.....	1
Castor oil.....	2
Fire clay.....	1
Insecticide.....	1
Oil, crude.....	1
Vomit.....	2
"Powdelac".....	1
Thymol.....	1
Toxicological examinations (police department).....	2
Acetphenetidin tablets.....	1
Bile.....	1
Test meal.....	1
Stool.....	1
Water, for detection of chlorin content.....	78
Agglutination reactions.....	194
Autopsies.....	578
Autopsies of cows.....	2
Bodies embalmed.....	77
Microscopical examinations, bile.....	1
Medico-legal post-mortems.....	19
Sections of tissue prepared, frozen.....	125
Sections of tissue prepared, paraffin.....	6,313
Standardization of clinical thermometers.....	7
Surgical pathological tissue and neoplasms reported.....	261
Vaccinations, antipest.....	7
Vaccination for plague.....	3
Vaccine inoculations, antityphoid.....	5
Vaccine treatment:	
Autogenous, prepared.....	69
Autogenous, administered.....	11
Wasserman reactions.....	3,079
Widal reactions.....	89

*Issues of quinine.*

Month.	Kilograms.	Pounds avoirdupois.
July.....	33.00	72.75
August.....	39.00	85.98
September.....	38.70	85.32
October.....	57.93	127.71
November.....	30.99	68.32
December.....	39.40	86.86
January.....	23.33	51.43
February.....	35.66	78.62
March.....	52.00	114.64
April.....	28.33	57.95
May.....	15.43	34.02
June.....	46.33	102.14
Total.....	438.10	965.74
Average per month.....	36.51	80.48

*Sanitation.*

## CITY OF PANAMA.

Anopheles brigade:		Cubic feet disinfected and fumigated....	817,176
Linear feet of ditches cleaned.....	1,057,119	Rooms fumigated and disinfected.....	205
Linear feet of ditches dug.....	6,371	Material used: Larvacide..... gallons..	3,950
Square feet of weeds and grass cut and removed.....	4,999,500	Destruction of rats:	
Cesspools cleaned.....	13	Number of rats caught and killed....	4,059
Cesspools filled.....	1	Average number of rat traps in use..	115
Wells filled.....	2	Inspection of houses and yards:	
Cubic yards of earth used in filling cesspools, wells, and holes.....	3,098	Houses and yards inspected.....	929
Loads of grass removed and burned..	2,748	Persons notified to keep premises in good condition.....	274
Disinfection brigade:		Warning notices complied with.....	298
Houses disinfected and fumigated for diphtheria.....	30	Letters to alcade requesting enforcement of sanitary rules and regulations.....	61
Houses disinfected for—		Old buildings condemned and demolished.....	71
tuberculosis.....	3	Yards cleaned.....	4,173
chickenpox.....	2	Loads of refuse removed from the city.....	4,373
cerebrospinal meningitis.....	2	New buildings:	
scarlet fever.....	3	Plans submitted to health officer and approved.....	247
leprosy.....	1	Permits granted for repairs to old buildings.....	220
poliomyelitis.....	7		
Houses disinfected and fumigated for typhoid fever.....	10		
Houses fumigated for yellow fever.....	6		

## COLON, CRISTOBAL, MOUNT HOPE, AND TORO POINT.

Water and sewers:		Sanitation of Colon—Continued.	
Connections made during the year...	115	Square yards of alleys cleaned.....	1,697,037
Total connections made to date.....	961	Square yards of streets sprinkled....	1,292,000
Outstanding permits.....	495	Fly-breeding places found.....	1,208
Houses in which extensions were made.....	41	Colon and Cristobal garbage disposed of at dump, Colon.....	
Houses:		Sanitation of Cristobal:	
Plans approved.....	139	Square yards of pools oiled.....	39,900
Permits to repair issued.....	427	Water receptacles treated.....	23,183
Permits to occupy issued.....	80	Mosquito-breeding places found.....	175
Temporary permits to occupy issued.	25	Mosquitoes killed in barracks.....	22,348
Houses in which defective plumbing fixtures were found and reported to Superintendent of Public Works..	241	Fly-breeding places found.....	151
Sanitation of Colon:		Sanitation of Mount Hope:	
Loads of yard garbage removed.....	5,559	Square yards of pools oiled.....	866,192
Average cans of garbage removed daily.....	2,087	Water receptacles treated.....	331,910
Acres of vegetation removed.....	26	Linear feet of ditches maintained....	194,582
Acres of streets cleaned.....	6,696	Crab holes worked.....	15,000
Private properties cleaned.....	676	Mosquito-breeding places found.....	1,310
Square yards of pools oiled.....	217,795	Linear feet of ditches constructed....	56,552
Mosquito-breeding places found.....	1,095	Square yards of vegetation removed..	16,119
Water receptacles treated.....	338,710	Mount Hope cemetery maintained...	
Linear feet of ditches constructed....	4,770	Sanitation of Toro Point:	
Linear feet of ditches maintained....	65,620	Square yards of pools oiled.....	254,096
Notice to abate nuisances served....	4,537	Water receptacles treated.....	61,938
Nuisances abated.....	3,192	Mosquito-breeding places found.....	532
Buildings inspected.....	43,695	Linear feet of ditches constructed....	13,359
Rats killed.....	1,103	Linear feet of ditches maintained....	120,846
		Crab holes worked.....	47,510
		Doses of quinine tonic distributed...	42,055
		Adult mosquitoes killed.....	21,623



*Sanitation—Continued.*

## CANAL ZONE.

Work requests on quartermaster's department:	
Grass cutting.....	860
Screen repairing.....	343
Miscellaneous.....	514
Work requests on engineering department.....	894
Work requests on other departments.....	71
Notice served for abatement of nuisances.....	2,170
Arrests for violation of sanitary regulations.....	224
Convictions.....	205
Building permits approved.....	238
Inspections of—	
Closets.....	81,295
Stores.....	9,759

## Inspections of—Continued.

Restaurants.....	3,071
Shops.....	2,562
Grabage cans emptied.....	2,402,612
Closets disinfected.....	187,171
Houses disinfected.....	87
Houses fumigated.....	4
Rat traps used daily.....	422
Water and sewer connections made.....	59
Adult anopheles destroyed at houses.....	554,960
Adult culices destroyed at houses.....	464,818
Containers found with stegomyia larvae.....	559
Materials used:	
Larvacide..... gallons..	124,956
Crude oil..... do.....	679,970
Rats destroyed.....	10,018

*Quarantine service.*

## PORTS OF PANAMA-ANCON AND COLON-CRISTOBAL.

Vessels inspected and passed.....	1,345
Vessels detained in quarantine.....	99
Vessels fumigated on arrival.....	102
Vessels fumigated prior to departure.....	38
Pieces of baggage handled and stored.....	12,266
Crew inspected.....	129,707
Passengers inspected.....	90,106
Total persons inspected.....	219,813
Persons vaccinated at ports of arrival because of compulsory vaccination law.....	14,527
Persons vaccinated at ports of departure or en route because of compulsory vaccination law.....	14,424
Total persons vaccinated.....	28,951
Persons held in quarantine at the detention stations to complete period of incubation of yellow fever or plague.....	6,098
Persons held in quarantine on board vessels to complete period of incubation of yellow fever or plague.....	16,289
Total persons held in quarantine.....	22,387
Persons landed from foreign ports:	
Cabin.....	25,277
Steerage.....	30,219
	55,496

## Persons embarked for foreign ports:

Cabin.....	26,296
Steerage.....	19,354
	45,650
Apparent increase for the year from foreign ports:	
Increase, steerage.....	10,865
Decrease, cabin.....	1,019
	9,846
Persons arriving from coast towns on small craft.....	31,453
Persons embarked for coast towns on small craft.....	28,053
Apparent increase for the year from coast towns.....	3,400
Total persons landed.....	86,949
Total persons embarked.....	73,703
Excess over number embarked.....	13,246
Less number for Pacific ports.....	3,712
Total apparent increase for the year.....	9,534
Immigrants recommended for rejection.....	87
Certificates issued to outgoing passengers.....	534
Persons refused certificates because of trachoma.....	71
Bills of health viséed.....	738

## BOCAS DEL TORO.

Vessels inspected and passed.....	349
Crew inspected and passed.....	19,600
Passengers inspected and passed.....	8,065

Passengers, in transit, inspected and passed.....	5,613
Persons held to complete period of incubation of yellow fever.....	144

*Personnel report.*

[Average number of employees at work during the year.]

Chief sanitary office.....	37
Property division.....	9
Quarantine service.....	40
Health office:	
Panama.....	47
Colon.....	124
Ancon Hospital.....	543
Colon Hospital.....	197
Santo Tomas Hospital.....	5
Taboga Sanitarium.....	22
Palo Seco Leper Asylum.....	15
Zone sanitation.....	255
Dispensaries:	
Ancon.....	5
Balboa.....	3
Bas Obispo.....	5
Corozal.....	4

## Dispensaries—Continued.

Cristobal.....	7
Culebra.....	10
Empire.....	8
Gatun.....	12
Gorgona.....	7
Las Cascadas.....	5
Margarita Point.....	1
Miraflores.....	5
Naos Island.....	2
Paraiso.....	4
Pedro Miguel.....	5
Porto Bello.....	4
Toro Point.....	3
Total.....	1,384

*Hospital cases of malaria among employees.*

Month.	Discharged.		Died.		Total cases.	Annual average death rate per 1,000.	Annual average number cases per 1,000.	Number of employees.
	White.	Colored.	White.	Colored.				
July.....	449	585	.....	3	1,037	0.74	255	48,714
August.....	416	501	1	1	919	.48	219	50,305
September.....	199	239	.....	.....	438	.....	103	50,948
October.....	151	149	.....	1	301	.24	72	50,103
November.....	130	141	.....	1	272	.23	62	52,539
December.....	162	213	1	.....	376	.22	84	53,810
January.....	215	281	1	2	499	.69	115	52,142
February.....	235	355	1	.....	591	.22	128	55,333
March.....	185	248	.....	.....	433	.....	92	56,258
April.....	82	152	.....	.....	234	.....	47	59,486
May.....	88	88	1	.....	177	.20	36	59,771
June.....	87	149	1	.....	237	.20	49	58,590
Total.....	2,399	3,101	6	8	5,514	.26	102	54,000

## APPENDIX Q.

### REPORT OF A. B. DICKSON, SUPERINTENDENT OF CLUB- HOUSES.

ISTHMIAN CANAL COMMISSION,  
OFFICE OF SUPERINTENDENT OF CLUBHOUSES,  
*Culebra, Canal Zone, August 1, 1913.*

SIR: I have the honor to submit herewith the annual report of the operations of the division of clubhouses for the year ending June 30, 1913, as conducted under the supervision of the secretaries furnished by the Young Men's Christian Association.

#### CHANGE IN BUILDINGS.

In August, 1912, it was found that the Culebra clubhouse was unsafe for further occupancy, on account of its proximity to Culebra Cut and the unsettled condition of the ground underneath the building.

Portions of the Culebra building were reerected at the rear of the Administration Building Annex, at a cost of about \$1,700, which was paid from clubhouse funds. Bowling alleys, pool and billiard tables, a soda fountain, barber shop, and a reading room were thus provided in this new location, and a cool spacious hall for entertainments was secured in the second story of the schoolhouse. That the employees at Culebra appreciate these privileges has been indicated by the large attendance at the activities run by the clubhouse, and the support given in this way has amply justified the expenditure made for these buildings.

During the past year work was carried on at Corozal, Culebra, Empire, Gorgona, Gatun, and Cristobal, on the Canal Zone, and at Porto Bello, about 20 miles down the coast. At the end of the fiscal year the gold force working for this division consisted of 1 superintendent, 7 secretaries, 4 assistant secretaries, 11 night clerks, 8 bowling-alley attendants, 6 pool-room attendants, and 6 barbers.

#### MEMBERSHIP.

	1912-13	1911-12	1910-11
Total membership at end of fiscal year.....	1,943	2,092	1,872
Average monthly membership.....	2,023	1,944	1,947
Largest membership any given month.....	<sup>1</sup> 2,127	2,092	2,121

<sup>1</sup> Largest since organization.

The usefulness of the clubhouses to the commission and the popularity of Y. M. C. A. work among employees is measured accurately by the number of employees who avail themselves of member-

ship privileges. Membership records show gratifying results as compared to other years. An average of 58 per cent of the gold employees residing in towns having clubhouse buildings were members of the Y. M. C. A. throughout the year, thus showing that a large proportion of the employees within reach of the buildings took advantage of the privileges offered. It should be remembered also that the families of employees may be admitted to some of the privileges by payment of a nominal fee.

#### ENTERTAINMENTS.

	1912-13	1911-12	1910-11
Companies engaged from the United States.....	5	7	5
Number of entertainments given.....	79	85	65
Total attendance.....	20,956	20,865	13,828
Entertainments, moving pictures and local talent.....	475	406	277
Total attendance.....	111,562	96,072	56,708

The entertainment feature has always been the most prominent activity in connection with Y. M. C. A. work on the Zone, and last year this feature was emphasized more than ever before, and the attendance was larger, as shown by the above figures.

The entertainers secured from the States were Miss Gay Zenola MacLaren, the Edith Harris Scott Co., Walter Eccles, and the Four College Girls, the Apollo Concert Co., and the Mary Lyon Concert Co.

Moving pictures were again the most popular form of entertainment offered employees. Permanent moving-picture booths were installed in six of the clubhouses, thereby increasing the seating capacity of the auditorium and assuring safety from fire. Weekly moving-picture exhibitions were given in each Y. M. C. A., and two new moving-picture machines were purchased during the year in order that extra exhibitions might be given when desired. It is proposed to eventually increase this equipment until each clubhouse is provided with a cinematograph of its own. Among the special multiple-reel exhibitions provided in addition to the regular shows, were "The Top of the World," "Life of Buffalo Bill," "Detective Burns," "From the Manger to the Cross," "The Battle of Calais."

Smokers, vaudeville performances, and concerts with local talent, have been given frequently, and have proven extremely popular.

#### BOWLING, BILLIARDS, AND POOL.

There were tournaments in progress during the entire year, with a total of from 25 to 150 men participating. The rivalry between the various Y. M. C. A.'s in interclubhouse games and sports has always been intense, and consequently the interest has been great, and large crowds have attended the games. Cups, gold, silver, and bronze medals, and other forms of prizes are given to the winners from time to time. There were 105,455 games bowled as compared with 104,954 for the previous year, and 88,085 in 1911, and 277,186 games of pool, as compared to 278,799 for the previous year, and 217,710 for 1911.

## PHYSICAL WORK AND ATHLETICS.

Physical directors of experience have continued gymnasium work, and have met with uniform success. The theory that men will not take systematic exercise in the Tropics has been disproven by the large attendance at these classes.

There has been special effort on the part of physical directors to meet the needs of the various men. Thus classes have been formed for married men, meeting late in the afternoon; one form of exercise has been given to those who sit at a desk all day, and an entirely different and lighter exercise to those whose work is out of doors.

Volley ball has been found very beneficial for office men, and several interassociation matches have been held. All-Isthmian tournaments in indoor baseball and basket ball have been stubbornly contested. A series of games was played between teams formed by the various clubhouses. The basket-ball championship was won by Empire, and the indoor baseball championship by Camp Elliott.

## RELIGIOUS WORK.

We have continued to hold song services and religious meetings at hours that did not conflict with the regular religious work in the Canal Zone. There was an average attendance of 96 at 172 services held during the year, and an average monthly enrollment of 74 in Bible reading clubs and schools.

## EDUCATIONAL WORK.

During the year "The Forum" was organized for the purpose of giving to our members a series of lectures on topics of the day. Among those on the Canal Zone who appeared in this course were Mr. W. B. Childers, whose topic was "Natural Law in the World of Labor"; F. A. Gause, whose subject was "Literature and Life"; S. P. Verner, in "The Man Who Came Back"; and Dr. A. J. Orenstein, on "The Fly Pest." Dr. C. A. Devine, secretary of the Charity Organization Society of New York, lectured on "The Abolition of Poverty" and Dr. Frederic Poole, of Philadelphia, told of his experiences with the Chinese. There were 34 lectures in this course, with an average attendance of 180.

The Spanish classes have continued without interruption, and many of the students after finishing the preliminary courses have continued their advanced studies to advantage. Classes were in session every month of the year, and there was an average monthly enrollment of 102.

About 800 new books, fiction and nonfiction, have been added during the year to the libraries of the clubhouses. An average of 3,255 books was drawn every month by 1,117 library members. Each association subscribes to the leading newspapers and periodicals of the day.

## REFRESHMENT COUNTERS.

The refreshment parlors are an extremely important feature of clubhouse work. They are the social headquarters of the community, and serve as rooms of rest and refreshment for tourists.

The receipts for this activity are lower than last year, due to the fact that the facilities for serving refreshments in the new building at Culebra are not as adequate as in the old. The total receipts during the past year were \$46,523.86 as compared with \$49,398.05 last year and \$36,421.08 in 1911. New equipment was added during the year for the serving of soft drinks.

## VISITATION OF THE SICK.

The men in charge of this work have continued to visit the hospitals at Colon and Ancon every Sunday, bringing cheer to the hearts of those confined in these institutions. Two thousand and fifty-two calls of this sort were made during the year, and a large amount of reading matter was distributed among the hospital patients.

## BOYS' DEPARTMENT.

Although they have no special rooms, boys from 10 to 16 years of age have been allowed special privileges in the clubhouses, the general plan being to arrange gymnasium work for them three times a week, and to allow them other general privileges that do not interfere with the privileges enjoyed by the men. Special hikes are arranged for the boys from time to time, and during the visit of the Atlantic Fleet all the boys were taken to visit the flagship.

Two afternoons a week have been set aside in which ladies may enjoy some of the privileges of the clubhouses. There has been a great deal of interest in bowling during the past year, and some of the ladies have made excellent records.

## CLUBS.

Chess, checker, debating, glee, and camera clubs were organized during the year. The most active of these clubs were the chess clubs, which flourished during the entire year. Interclubhouse games were played, and on several occasions expert players from one town would play simultaneous matches against all the players of another town.

Glee clubs and mixed choruses were organized in some of the towns and gave excellent concerts.

The dark rooms were very well patronized, and the interest in amateur photography increased during the year. At some of the Y. M. C. A.'s, large exhibitions of amateur photographic work were held.

## VISIT OF THE ATLANTIC FLEET.

During the visit of the Atlantic Fleet in January and February, 1913, the Y. M. C. A. was asked to serve a light lunch on the special sightseeing trains that carried the members of the fleet from Colon to Panama and back. A force of waiters was recruited from among the silver employees of the clubhouses, and sandwiches, fruit, and lemonade were served each day on the train carrying from 700 to 1,000 men. In this manner, nearly 13,000 sailors were served at a nominal cost, thus giving them a better lunch than they could have otherwise secured, and enabling them to devote entirely to sightseeing the short time allotted them in Panama City.

## FINANCES.

	1912-13	1911-12	1910-11
Disbursements from commission funds.....	\$49,925.96	\$50,565.61	\$51,193.90
Disbursements from clubhouses.....	<sup>1</sup> 138,134.02	114,732.02	81,510.51
Receipts for the year.....	<sup>1</sup> 140,630.06	118,390.56	91,723.76
Net balance June 30.....	19,547.73	16,803.74	11,945.20

<sup>1</sup> Increase due largely to handling cigar and candy counter by cash instead of coupon system.

The financial management of the clubhouses continued in the hands of an advisory committee appointed by the chairman and chief engineer. This committee consists of Col. W. C. Gorgas, chief sanitary officer, chairman; Mr. H. A. A. Smith, examiner of accounts; Mr. Joseph Bucklin Bishop, secretary of the commission; and Mr. A. B. Dickson, superintendent of clubhouses.

The general supervision of activities in each clubhouse is in the hands of an executive council, appointed by the international committee. This council is made up as follows:

Corozal: Mr. H. O. Cole (chairman), Mr. J. C. Keller, Mr. L. H. Crafts, Mr. J. H. Humphries.

Culebra: Mr. E. E. Lee (chairman), Mr. J. H. Warner, Mr. J. H. Smith, Mr. H. G. Cornthwaite.

Empire: Mr. A. S. Zinn (chairman), Mr. T. L. Clear, and Mr. W. G. Ross.

Gorgona: Mr. Le Roy Smith (chairman), Mr. R. C. Shady, Mr. C. E. Whipple, Mr. Harry Otis, Mr. Frank B. Ferebee.

Gatun: Col. Wm. L. Sibert (chairman), Mr. R. M. Gamble, Mr. W. B. Childers, Dr. A. G. Farmer, Mr. W. C. Gayer.

Cristobal: Judge Thomas H. Brown (chairman), Dr. A. C. Hearne, Dr. C. C. Pierce.

Porto Bello: Mr. Walter Thomson (chairman), Mr. James L. Tolar.

Respectfully submitted.

A. B. DICKSON,  
*Superintendent of Clubhouses.*

Col. GEO. W. GOETHALS, United States Army,  
*Chairman and Chief Engineer,*  
*Culebra, Canal Zone.*





## APPENDIX R.

### REPORT OF MAJ. F. C. BOGGS, CORPS OF ENGINEERS, UNITED STATES ARMY, GENERAL PURCHASING OFFICER AND CHIEF OF THE WASHINGTON OFFICE.

ISTHMIAN CANAL COMMISSION,  
*Washington, D. C., July 18, 1913.*

SIR: I have the honor to submit the following report upon the work of this office during the fiscal year ending June 30, 1913:

No changes have been made in the organization of the office during the past year, and the following divisions still remain under my charge as general purchasing officer and chief of office of the Isthmian Canal Commission: General office, disbursing office, office of assistant examiner of accounts, appointment division, correspondence and record division, and purchasing department.

The work of the appointment division has been very heavy throughout the year, the increase over the preceding year in the number of appointments being 87 per cent, in volume of correspondence 44 per cent, and in arranging steamship transportation of passengers to the Isthmus 34 per cent. In order to fill promptly the requisitions for skilled mechanics it has been necessary to send an employment agent into the field three times during the past year, a sufficient number of qualified men having failed to apply direct to the Washington office. During the last 12 months 2,065 persons within the United States were tendered employment for duty on the Isthmus in grades above that of laborer; 1,183 accepted and were appointed, covering 59 different positions. Six thousand two hundred and thirty-nine persons, including new appointees, those returning from leave of absence, members of employees' families, and employees of contractors of the commission and their families, were provided with transportation from the United States to the Isthmus; and in response to inquiries and applications for employment during this period, and in the issuance of appointments, 22,533 letters were written, 4,372 telegrams sent, and 22,624 circulars mailed.

The work of the correspondence and record division, comprising all general or administrative correspondence and miscellaneous matters, has been continued along the lines described in previous annual reports.

The following statement shows the volume of the transactions of the disbursing office during the past fiscal year:

#### *Claim statement.*

On hand July 1.....	\$508
Received July 1 to June 30.....	23,908
Total.....	24,416
Passed for payment July 1 to June 30.....	24,072
On hand June 30.....	344

*Financial statement.*

On hand July 1, 1912.....		170, 264. 08
Receipts:		
From United States Treasury.....	\$15, 530, 000. 00	
Liquidated damages.....	224, 368. 55	
Cash discounts.....	787. 50	
Miscellaneous collections.....	125, 885. 94	
		<u>15, 881, 041. 99</u>
		<u>16, 051, 306. 07</u>
Disbursements:		
Claims paid.....	15, 454, 202. 43	
Deposits to miscellaneous receipts.....	124, 330. 90	
		<u>15, 578, 533. 33</u>
Balance on hand June 30, 1913.....		<u>472, 772. 74</u>
		<u>16, 051, 306. 07</u>

Claims aggregating \$141,470.67, which were examined in this office and settled by the Auditor for the War Department either by direct or transfer settlements, are not included in the above statement.

The office of the assistant examiner of accounts is charged with the duty of giving all accounts, before transmission to the auditor, an administrative examination, and during the fiscal year 13,743 vouchers for payments amounting to \$15,161,945.54, and 750 direct and transfer settlements aggregating about \$200,000, were given an administrative examination. The cash and net balances stated on the account current have been examined.

It is also the duty of the assistant examiner of accounts to classify on an abstract to be sent to the Isthmus all expenditures in the United States.

A record of moneys collected, deposited, and reappropriated under the act of March 4, 1909, has been kept by this office.

The collections made or required to be made by the disbursing officer are checked up from time to time.

A monthly statement of the disbursing officer's balances is obtained from the Treasury Department and transmitted to the Isthmus.

All written contracts are prepared in this office, and during the last year 125 contracts, involving an expenditure of about \$7,000,000, were prepared.

This office prepares all correspondence in relation to annual bonds on proposals, including all forms relating thereto.

Cases involving questions of law to be decided by the general purchasing officer are usually referred to the assistant examiner of accounts for examination and report, and reports for the defense of suits in the Court of Claims are prepared by him.

The annual inventory of commission property in the United States is verified by the assistant examiner of accounts.

The purchasing department as now organized was by Executive order, dated August 15, 1907, placed under the supervision of the Chief of Engineers, United States Army, with an officer of the Corps of Engineers in charge as general purchasing officer. Headquarters of the department are located at Washington, D. C., from which office the principal purchases are made. Additional offices for the purchase of materials which can best be obtained locally are maintained at New York, San Francisco, and New Orleans, these offices also arranging for the receiving and shipping of all materials which

are purchased for forwarding to the Isthmus through their respective ports. Medical and hospital supplies are bought through the medical supply depot of the Army which is located in New York, a small force of employees of the commission being detailed in that depot to carry on the work under the officer in charge.

No change has been made in the method of purchasing during the past year; the same system of circular invitations for bids and award thereon as described in previous annual reports still prevails. A wide distribution of circulars is obtained by newspaper advertising and through the field offices of the Corps of Engineers, which are located at various points in the United States. Manufacturers in all parts of the country are thereby enabled to learn the commission's requirements and to submit bids for delivery through ports nearest their plants. The system originated in April, 1909, of making annual contracts for staple articles was continued during the past year with the usual success, but due to the approaching completion of the construction work it was not thought advisable to advertise as many materials for contracts in this manner during the coming fiscal year, and these annual contracts will, therefore, be reduced to a small number.

Increased efforts were made during the past year to induce foreign firms to bid on our requirements but with very unsatisfactory results, except where material called for was essentially a foreign product and one not ordinarily manufactured in the United States.

Materials purchased are inspected in the United States before shipment, the right being reserved to make final inspection on the Isthmus after arrival there. To conduct the preliminary inspection a force of inspectors is employed under the direction of the inspecting engineer in Washington. Inspections are also made, when practicable, by the field offices of the Corps of Engineers. Independent inspection forces are also located at Pittsburgh, Wheeling, and Ambridge to handle such special work as the lock gates, electrical machinery and emergency dams, and these inspection forces report directly to the authorities on the Isthmus.

When more convenient, certain portions of the inspections which would ordinarily fall under the Washington office are made by these additional forces and vice versa the Washington office frequently handles minor inspections for these special offices when the Washington office inspector is more conveniently located for handling same. Valuable assistance in the work of testing and inspecting samples is rendered the commission by the Bureau of Standards, the Bureau of Mines, the Bureau of Chemistry, and the Medical Department, the Ordnance Department, and the Quartermaster Corps of the United States Army.

The work of the purchasing department and all allied departments has been much greater this year than in the past. The number of orders placed during the past fiscal year was 7,087, as against 5,960 placed in the fiscal year 1911-12. The reason for this large increase in the number of orders is undoubtedly due to the policy adopted on the Isthmus of diminishing the amount of stock to the lowest practical figure, it being desirable to have as little stock on hand at the end of the construction period as the needs of the work will permit. This policy has, however, meant an increase in the number of small

orders and an increase in the number of rush and open market purchases.

The total value of orders placed for the fiscal year ended June 30, 1913, by all of the offices of the purchasing department in the United States was \$12,335,973.12, the most important contracts for permanent equipment being structural material for locks and spillways, \$241,326.33; machinery for their operation, \$740,302.02; electric locomotives and tracks, \$548,732.67; hydroelectric station, \$72,540.34 dock material, \$571,723.48; administration building, \$99,750; shop buildings and machinery, \$593,649.51; seven electric overhead traveling cranes, \$61,715; Cristobal-Balboa transmission line, \$688,503.38; 57 light buoys, \$164,970; two 250-ton revolving floating cranes, \$837,500; Colon filtration plant, \$68,006.75; and four oil storage tanks, \$62,800. Other principal items of purchase included six 1,000-yard steel dump barges; two 15-yard dipper dredges; 6,310,000 pounds of dynamite; 23,505,695 feet of lumber; 20,796 piles; 243,500 crossties; 198 sets of switch ties; and 2,969 gross tons of steel rails. Under a contract of January 7, 1909, for 4,500,000 barrels of Portland cement, and a supplemental contract of September 13, 1912, covering additional quantity necessary to complete the work, 1,303,762 barrels of cement were delivered during the past year, making a total of 5,657,786 barrels supplied under this contract.

Very respectfully,

F. C. BOGGS,  
*Major, Corps of Engineers, United States Army,*  
*General Purchasing Officer, Chief of Office.*

Col. GEO. W. GOETHALS, *United States Army,*  
*Chairman and Chief Engineer,*  
*Culebra, Canal Zone.*

## APPENDIX S.

### REPORT OF DONALD F. MacDONALD, GEOLOGIST.

CULEBRA, CANAL ZONE, *August 1, 1913.*

SIR: I have the honor to submit the appended report on the geology of the Canal Zone, to accompany the annual report for the fiscal year ended June 30, 1913.

DONALD F. MacDONALD,  
*Geologist.*

Col. GEO. W. GOETHALS,  
*Chairman and Chief Engineer, Culebra, Canal Zone.*

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## ISTHMIAN GEOLOGY.

## I. INTRODUCTORY.

Isthmian geology has three divisions of interest: Its direct bearing on canal construction, its contribution to scientific knowledge, and the information that it gives regarding the mineral resources of the regions examined. As a matter of fact, all three of these divisions have some relation, direct or indirect, to canal construction.

Geologists have, of course, visited this region in the past. Not, however, until canal and Panama Railroad construction work broke through the jungle and soil cover of hill and valley were there areas of rock exposures sufficient for fairly detailed geological study. To-day, thanks to these excavations, rock specimens have been gathered, fossils collected, and data made available which soon will make the Isthmian geological section a standard of comparison for future geological studies throughout the whole Carribean region. The history of the joining together of the North and South American continents is contained in the geological studies of the Isthmian region. This fact is of special importance to science in general, but particularly to geologists, and to those biologists who have to do with problems that have a bearing on the north and south intercontinental migrations of flora and fauna. This report will, of course, contain only the outline of the Isthmian geological story.

## II. GEOGRAPHY.

The surface configuration of a country is always a considerable factor in the solution of the engineering problems of that country. It will, therefore, be of interest to briefly consider the three different types of topography or surface configuration that are to be found on the Isthmus. They are (1) the mountain type, consisting of more or less individual groups of mountain peaks, from 2,000 to 11,000 feet high. This type is not represented within the Canal Zone; (2) the hill and mesa type, consisting chiefly of irregular angular hills, short ridges, crooked, unsymmetrical valleys, and angular depressions and basins; (3) the coastal-plain type, which flanks at intervals both the Atlantic and Pacific coasts of Panama and much of Central America.

The hill type of topography is well shown in the middle and southern parts of the Canal Zone, and two of the hills reach up approximately to 1,000 feet above sea level. Plates 65 and 66 show these hills. They present some likeness, in their green jungle-covered irregular surfaces, to enormous cross waves at sea. There are within the Canal Zone no mesas or flat-topped hills, but outside the Zone these occur locally, associated with this type of topography. The Quadranchia Hills east of Gatun and the ridges west of Gatun Dam are fairly even crested, but, of course, they are not mesas.

The coastal-plain type (plate 67) is fairly well represented on the northern or Atlantic end of the Zone. It may be present as a coastal swamp a mile or less wide, or it may be a plain which slopes upward very gradually from sea level to where it may attain an elevation of some hundreds of feet at say 10 to 15 miles inland. Where this is so, streams have locally eroded away its former surface, so that now only remnants of its original elevation are left as low hills occupying inter-

stream positions. These coastal-plain areas, especially on the Atlantic side, have had a very considerable influence on the history of the country. They are mostly very fertile and are the chief source of the great Central American banana industry. They are also very malarial and generally unhealthy. The coastal plain, especially on the Pacific coast, is divided off into different areas by spurs from the central highlands. These cross-hill areas generally form headlands, and extend beyond the coast line as groups of islands.

#### A. AGRICULTURE.

The American people have manifested considerable interest in the agricultural possibilities of the Canal Zone. Briefly, what are these possibilities? The greater part of the Canal Zone land consists of hill country above described. On these hills the soil is generally shallow and rocky, and in a few years of successive cultivation of the same areas the heavy tropical rains would wash away a goodly part of it. Besides the steepness, rockiness, and generally shallow soil conditions of the hill region it must be recognized that the climate here is such that American farmers after a decade, more or less, would in most cases not have sufficient energy and ambition left to insure their success. On the richer lands of the valleys and coastal-plain areas the problem of sanitation would have to be financed. No individual farming community could ever hope to pay the bills of a successful war on mosquitoes and other pests. Any American farmer would, indeed, be badly off if he had to get his daily rice by cultivation of Canal Zone lands. Of course this unfavorable outlook does not apply to all of Panama. In the western provinces, especially those of Chiriqui, Veraguas, and Los Santos, there are high mountain valleys with cool and healthful climate where coffee, cattle, and other tropical and semitropical agricultural pursuits give considerable promise of good returns. Even the flat llano lands of Chiriqui and Veraguas grow good crops of grasses, rice, corn, and citrus fruits, and nourish healthy herds of cattle.

#### B. TIMBER.

Most of the useful timber within the Canal Zone was harvested years ago. What remains has but little commercial value outside of the fact that it serves a few local wants. There are other parts of Panama, however, outside the Canal Zone, that have fairly good forests of useful timber.

### III. GENERAL GEOLOGY.

#### A. INTRODUCTORY.

Within the Canal Zone there are many varieties of rock. All of the different varieties, however, can be included in 11 groups or formations of bedded rocks and 6 groups of igneous rocks. Each formation may consist of several different kinds of rock, but these are merely local variations or different members of the same family. The several formations are distinct from each other in age, in character of material, and in mode of formation. Plate 68 is a generalized geological section across the Isthmus, showing the different forma-

tions between the Atlantic and the Pacific shores. Plate 69 shows the rock succession and is the legend or key to plate 68. The two oldest formations contain no fossils, so their age is unknown. The lower part of the Bohio conglomerate is also of unknown age. The other formations range from Oligocene to late Pleistocene. The Miocene is, so far as known, not represented in the rock succession. Correlation across the Isthmus is a difficult matter because of sparsity of outcrops, hence further work may slightly modify the conclusions reached herein.

#### B. ROCK FORMATIONS.

1. *Bas Obispo formation*.—The Bas Obispo formation, the oldest Isthmian formation so far known, and probably of pre-Tertiary age, is a volcanic breccia, with some local meta-conglomerate of andesitic composition. It is formed of andesitic fragments and ash blown out of old volcanic vents. This débris settled down over the surrounding region and was subsequently cemented into fairly hard rock. Locally it shows some rough bedding, and it outcrops extensively at Bas Obispo, and near Old Panama, and small outcrops rise above the alluvium near Miraflores and Diablo Ridge.

2. *Las Cascadas agglomerate*.—The Las Cascadas agglomerate overlies the basalt breccia and outcrops extensively along the canal between Empire and Las Cascadas. It consists of greenish to gray basic agglomerate, which contains large and small subangular fragments in a fine-grained ground mass of volcanic clay and tuff. (Plate 70.) The whole is arranged in massive, to roughly bedded, unconformable deposits. Interbedded with these are andesitic flow breccias, some fine-grained grayish and some coarse-grained dark andesitic flows, and a few easily crumbled lava-mud flows which show columnar jointing where exposed in the canal. The whole is cut by large and small basalt dikes.

3. *Bohio conglomerate*.—The Bohio conglomerate consists of two members. The lowermost of these is, so far, of indeterminable age, but seems to be considerably younger than the Las Cascadas agglomerate. It consists of gravel, cobbles, and boulders up to several feet in diameter, fairly well bedded but locally massive. Interbedded with the coarser material are sandstone and argillite layers. The uppermost member is of the same general composition but contains some beds of dark gray foraminiferal marls, probably of early Oligocene age. The cobbles and boulders in both formations are cherts, andesites, basalts, and diorites and were derived from the older intrusive masses of igneous rock now found at intervals along the central part of the Isthmian region. The formation is probably nearly one thousand feet thick, and it outcrops extensively in the vicinity of Bohio and near Gamboa Bridge and Caimito Junction.

4. *The Culebra formation*.—The Culebra formation is the oldest series that has so far yielded many determinable fossils. Drs. W. H. Dall and T. W. Vaughan, United States Geological Survey specialists in the study of Tertiary fossils, regard its fauna as very likely belonging to the latter part of the Oligocene. When they shall have carefully studied the collection the age will be clearly established. The formation consists of an upper and a lower member. The lower member (*a*) consists of dark, well laminated beds of soft shales, marls, and carbonaceous clays, with some pebbly, sandy, and tufaceous



layers, and a few thin beds of lignitic shale. It outcrops in Culebra Cut, near Culebra, and near Pedro Miguel. The upper member (*b*) consists of beds and lenses of sandy limestone to calcareous sandstone 3 to 10 feet thick, separated by partings of carbonaceous clays and fine bedded tuffs (plate 71). Locally this formation gives off a little natural gas and in some restricted areas it shows slightly bituminous shales so that it is possible that it may be the source of the oil seepages found in Darien. Oral accounts of some of the rocks of that region favor this idea. The formation must have at least 500 feet of thickness.

5. *Cucaracha formation*.—The Cucaracha formation consists of greenish, fine-grained clay with some local red beds. It is fairly massive but contains a few beds of lignitic shale, some lenses of gravel, sandy beds, and one extensive flow of gray andesitic lava about 20 feet thick. It outcrops along the canal near Rio Grande and on both sides of Gold and Contractors Hills. Its chemical composition is andesitic, and it is cut by some basalt dikes (plate 72). This formation is about 400 feet thick and is somewhat restricted in area.

6. *Emperador limestone*.—The Emperador limestone lies unconformably on several of the older beds. It is a light-colored, fairly pure limestone, which contains many corals, some pelecypods, and other marine fossils. Its outcrops are somewhat flaggy and occupy comparatively small areas. Near Las Cascadas a section cut by the canal shows five different beds (plate 73), some of which are marly sandstone. The lower beds are 4 to 6 feet and the upper one about 25 feet thick. The formation outcrops northwest of Empire, south of Las Cascadas, on the relocated line of the Panama Railroad, near San Pablo, near Frijoles, in the swamp southeast of Diablo Bridge, and extensively near Alhajuela. It is a good horizon marker, seems to extend over a wide area, and it is thought that any oil-bearing beds which may be discovered within the Republic of Panama will probably lie not far below this limestone. The formation also has possible value as a local source of lime.

7. *The Caimito formation*.—The Caimito formation consists of (*a*) light-gray marly argillite, which overlies the Emperador limestone, and which grades into a yellowish and somewhat spherical weathering argillitic sandstone, bluish gray on fresh fracture; (*b*) a peculiarly calcareous conglomerate with some fragments of much decayed basic rock, which locally give a bright green stain to small patches of the formation; (*c*) more yellowish spherical weathering argillitic sandstone. (*a*) is found mostly overlying the limestone, and is thought to be the rock which outcrops in the Chagres River at Barbacoas, near San Pablo. (*b*) and (*c*) may be seen in the section at Bald Hill north of Miraflores. (*b*) outcrops extensively at San Pablo, and near the site of the proposed wireless-telegraph station opposite San Pablo. This whole formation has at least 400 feet of thickness.

8. *Panama formation*.—The Panama formation, first named by Hill, in his Bulletin on the Geology of Panama,<sup>1</sup> is a light-colored, well-bedded tuff, somewhat acid in composition and locally contains some argillitic beds. It has a few fossils, and outcrops extensively from Miraflores to Panama, and locally in some other places. The formation is at least 400 feet thick and overlies the Caimito beds.

<sup>1</sup> Bulletin of the Museum of Comparative Zoology, Harvard College, Vol. XXVIII, No. 5, The Geological History of the Isthmus of Panama and portions of Costa Rica, by Robt. T. Hill.

9. *Gatun formation*.—This formation consists of three members: (a) About 500 feet of marls and argillites, containing many marine fossils, and some beds of soft sandstone and conglomerate. It is dark gray in color, except locally, where many brown specks indicating fragments of organic material are shown. (b) Mostly fine soft sandstone, about 100 feet thick, containing a few fossils. (c) Light-colored indurated clay beds. The formation is very extensive and constitutes the foundation on which the Gatun Locks are built. The upper part of the formation weathers into red clay, and except where this is cut through by streams it covers the solid rock to a depth of 20 to 25 feet. Large collections of fossils have been made from these beds, and from a study of them it is known that the formation was deposited in Oligocene time. The light-colored indurated clay beds forming the upper part of the Gatun series seem to correspond to the Panama formation, while the Caimito formation may be the equivalent of the middle and the lower Gatun beds.

10. *Caribbean limestone*.—The Caribbean limestone (Gabb's Antilite) is a sandy fragmental limestone, locally a coquina or shell marl. It fringes the Caribbean coast, forming low bluffs on many of the headlands. Near the river mouths and the lower ends of the valleys it is generally absent. It outcrops at Toro Point, west of Gatun Dam, and at the mouth of the Chagres River, and is the rock from which Fort San Lorenzo was built. From its fossils it is provisionally referred to the Pliocene (?). In Costa Rica this limestone fringes the Caribbean shore in many places, and inland from it are argillite beds of the same age.

11. *Pleistocene formations*.—These consist of (a) bench gravels up to 100 feet above present river level; (b) swamp formations filling old channels to depths of 375 feet below present sea level; (c) river gravels 10 feet above present flood-plane level, old sea beaches 6 to 30 feet above present beach level; (d) shoals, beaches, and present river alluvium.

#### C. IGNEOUS ROCKS.

The igneous rocks within the Canal Zone—those which cooled from the lava state—belong to six distinct groups or families. Three of these are shown on the geological section, plate 68. The others are in place within some miles of the canal. They are—

1. *Granodiorite*.—A quartz bearing, locally porphyritic rock, a member of the broad group of granite rocks. It forms Cocovi Island, a small island in Panama Bay. Granite float or gravel is found, among other rock débris, in the Chagres River. This shows that somewhere within the Chagres drainage basin there is a mass of granite rock.

2. *Diorite*.—A rock much like granite, but with no free quartz and with much dark hornblende, is found as rounded fragments among the gravel of the Chagres and in the Bohio conglomerate. A small mass of it outcrops at Point Farfan, opposite Balboa. Both diorite and granodiorite form some of the core masses of the mountains in the interior of Panama.

3. *Andesite*.—A rock of about the same chemical composition as diorite is known at a few places in the Canal Zone. It differs from diorite in having reached the surface as a lava magma, while diorite

cooled below the surface and is therefore generally much more coarsely crystallized. A flow of this type of rock shows in Culebra Cut. It is somewhat remarkable in that it is more than a mile long, of unknown width, and less than 20 feet thick. It flowed out on an old land surface when about half the present thickness of the Cucaracha formation was deposited, so that it now appears sandwiched in between the upper and the lower parts of this formation. Volcanic necks and dikes of andesitic rock cut the Las Cascadas agglomerate in various places. Similar dikes seem to cut the diorite at Point Farfan, opposite Balboa.

4. *Rhyolite*.—A rock with the same chemical composition as granite, forms Ancon Hill, plate 74. It differs from granite in that it came to the surface and cooled quickly before it had time to crystalize fully. Granite may be thought of as a rhyolite which cooled below the surface, very slowly, with plenty of time to crystalize well. This rock is of special importance, because, in crushed form, it was used for the concrete work of the Miraflores and Pedro Miguel Locks. Ancon Hill is a large dike or tabular mass of rhyolite which was injected in lava form through the surrounding rocks. No other important rhyolite mass is known on the Isthmus.

5. *Meta-breccia*.—Under this heading are classed the metamorphosed tuff, clay, agglomerate, and breccia masses that form Gold Hill, Contractor's Hill, Office Hill (Culebra), the breccias at Paraiso, at Empire, and at other places. Around at least a part of the periphery of several of these masses, and sticking up through all of them in one or several places, are basalt dikes. All of these masses are separated from the rocks which surround them by a contact along which faulting has occurred. Both the Gold Hill and the Contractor's Hill masses have been faulted downward some hundreds of feet. (See plates 75 and 76.) These meta-breccias are similar to certain phases of the Bas Obispo breccia. Disturbed bedding is found in their upper parts, so that a vertical section of them would look like a vertical section through the upper part of the Bas Obispo, and a part of the overlying Las Cascadas agglomerate, with some higher bedded tuffs included. From this evidence it seems certain that these meta-breccia masses were punched upward as somewhat metamorphosed and toughened caps on top of basalt plugs or cores. On cooling, shrinkage and outlets for various dikes and apophyses, caused a gradual settling back of these plugs to about their present position. Geologists who have not seen these masses may question this hypothesis; probably scarcely as searchingly, however, as the writer himself did when he first framed it.

6. *Basalt*.—A dark, quite basic, fine-grained lava rock is quite plentiful on the Isthmus. As dikes it shows in Culebra Cut near Empire, Culebra (plate 72), and Pedro Miguel. As more massive intrusions it forms Office Hill, at Empire, the top part of Gold Hill; also hills near Paraiso, Pedro Miguel, Rio Grande, and many other places. In fact most of the steep hills and ridges within the Canal Zone except Ancon Hill (plates 65 and 66) are formed of hard basaltic rock which formerly came up through the softer rock as dikes and cores of lava. The basalt near Culebra Cut contains practically no olivine, while that found in many other places is rich in this mineral.

In addition to the igneous rocks above enumerated, there are several cooled and hardened mud lava flows, which are found in

the Las Cascadas agglomerate. These local masses often show columnar structure and are quite hard, but on exposure to the air for a few years they crumble very considerably.

#### IV. HISTORICAL GEOLOGY.

##### A. ORIGIN OF FORMATIONS.

The oldest rocks within the Canal Zone indicate two periods of volcanic activity of the explosive kinds: (1) The materials which went to form the Bas Obispo formation were ejected from craters as volcanic ash and fragments of hot rock. This took place probably previous to Tertiary time. (2) A lesser and more localized volcanic period gave the Las Cascadas agglomerate; a formation composed mostly of somewhat bedded and sorted volcanic débris. The agglomerate formation is so much less consolidated and cemented together than the Bas Obispo rocks that it must have been formed a long time subsequent to the date of origin of the latter. These formations are separated from each other by an unconformity—a period when no rock formations were deposited. This is evidence that the first period of volcanic activity was followed by a long time of quietude before the second briefer explosive period began. During the first of these periods numerous islands of volcanic origin seem to have been raised in the shallow ocean which occupied the site of the present Isthmus. At the end of the second period the land rose considerably and streams became active. The streams, with their activity greatly increased from the rise of the land, gathered abundant sand and sediment among the volcanic débris. This they carried and sorted so that now it forms the bedded, slightly cemented, conglomerate here referred to as the Bohio formation. Toward the close of the period during which the Bohio conglomerate was deposited the land had become considerably worn down so that only relatively fine sediments were being washed into the numerous shallow bays and straits that separated the then islands of the Isthmian archipelago. Conditions of this kind existed throughout the time when the Culebra formation was being deposited. Local beaches and coral reefs had been formed, and these created some landlocked sloughs and estuaries that were shallow and had not much tidal current. Locally, marine swamps flourished, and the vegetable remains from these, together with depositional débris, furnished the carbonaceous clays and lignitic shales that now characterize the Culebra formation.

The Culebra period of deposition was ended by a gradual rise of the land, so that areas formerly under water were emerged. This retreat of the shore line left shore gravels over a part of the Culebra formation, and we find these gravels to-day separating the Culebra from the overlying Cucaracha rocks. Deposition of sediment, washed down from the higher land, still went on over the emerged surface, and this land-deposited material forms the present Cucaracha formation. That this formation contains lignitic shale beds is due to the fact that swamp conditions locally prevailed while it was being laid down. This period ended by a sinking and submergence of much of the land except the higher hills which stood up as islands. With this sinking began the building up of numerous coral reefs among the islands, and these coral reefs later went to form the Emperador limestone.

The limestone-depositing period was ended by another rise of land which increased the activity of streams and general erosion, and caused the sediments which now form the Caimito formation to be washed down from the higher lands. Some of these sediments were left as land deposits and some were deposited in water. A further local upraise of land over the site of the present Bay of Panama brought up an area of old rhyolitic tuffs such as those which now form the main part of Taboga Island, and other small islands in Panama Bay. Material eroded from these was deposited on the surrounding low land and in the shallow water, and this seems to have been the origin of the Panama formation.

While the upper part of the Caimito formation and the Panama beds were being formed on the central and southern portions of the Isthmus, the Gatun formation was being laid down on the northern side. The age relationship of these formations is based largely on fossil evidence, as it has been found extremely difficult to trace the different beds clear across the Isthmus. The Gatun formation was deposited in the ocean not far from the shore. This is shown by the many marine fossils, and the fragments of wood and organic matter that it contains.

The depositional epoch during which the Gatun and Panama formations were laid down seems to have ended, probably in late Oligocene time, by a general rise of the land. During the following period—the Miocene—the land remained emerged, for no bedded rocks of that age have been found. Intrusions of basaltic, andesitic, and rhyolitic lavas were injected up through all the rocks older than the Miocene, so it is thought that the closing period of Isthmian volcanic activity took place in Miocene time. It is to be noted that this last period of volcanism was of the quiescent kind, entirely different from the explosive volcanic action that gave the materials for the Bas Obispo and Las Cascadas formations. There is evidence that post-Miocene volcanic action formed Chiriqui Mountain, in Western Panama, and there may be other examples of Pliocene or Pleistocene volcanism in the high mountains of the interior.

At the close of the Miocene a sinking of land occurred, for we find rocks belonging to the next period which contain marine fossils, so that it is quite certain they were laid down in embayments of the Pliocene sea. This submergence continued up into the Pleistocene, for the Caribbean limestone was deposited in Pliocene or early Pleistocene time.

Toward the middle of the Pleistocene the land rose until it attained an altitude of more than 400 feet above its present elevation. This is known to a certainty because the old Pleistocene channel of the Chagres River, at Gatun, is about 375 feet below present sea level, and such a depth could not have been excavated by the river except under conditions where the land stood much higher than now. After middle Pleistocene time a gradual submergence began. This went on until the land in the vicinity of Colon stood about 8 feet lower than now. In the vicinity of Aguadulce this period of submergence carried the land 25 feet below its present elevation. As it sank the sea invaded the lower ends of the valleys and these became gradually silted up by stream sediments. On these shallow silted areas swamp vegetation flourished. Silting and vegetable growth kept pace with the sinking and thus were formed the swamp areas along the seacoast,

near the mouths and in the lower parts of streams. It is thought that the chief period of faulting which broke and sheared the Canal Zone rocks to such a notable extent took place chiefly with the sinking of the land after middle Pleistocene time.

#### B. RECENT RISE OF ISTHMIAN LAND.

The last land movement has been an emergence. This took place within historic time, according to the following evidence: About 7 miles southwestwardly by from Aguadulce, 80 miles southwest of the canal, the natives have excavated a shell mound, the material from which they burn for lime. This shell deposit is on the base of a small hill, which rises about 75 feet above the flat coastal plain that extends to the sea, half a dozen miles away. The surface of the plain at this point is about 25 feet above sea level. The mound contains many different varieties of shells, and mixed in with these are numerous fragments of broken crockery, indicating clearly that this is an ancient kitchen midden. From half an inch to a foot of soil has accumulated over the surface of the shells. From the evidence it is clear that this marked a canoe landing and small fishing village when the sea covered the low coastal plain and the present hill formed one of a small group of islands. The other islands, now hills, lie outside of this one and formerly sheltered it from the open sea. Here then the rise of land has been 25 to 30 feet within one or two thousand years. There is little doubt that the raised beaches in the vicinity of Colon, which indicate an emergence of 6 to 10 feet, were at present sea level within 2,000 years and probably much more recently.

This whole problem of land oscillation has a direct bearing on the canal, for if it went on rapidly it would in time undo the work of canal construction. After studying the matter, however, and tracing the different times of emergence and submergence as recorded in the geological section, the conclusion is reached that the canal can be in no danger from the above-described latest emergence of the Isthmian land. This emergence is slow and liable to stop or change into a contrary movement, as it has been shown, in the foregoing pages, to have done many times in the past. It therefore can not be considered as a danger to the great waterway.

### V. ECONOMIC AND ENGINEERING GEOLOGY.

#### A. INTRODUCTORY.

Since the days of Spanish occupation stories attributing rich mineral deposits to the Isthmus have persisted. Even to-day "Lost Spanish mine" myths find credence among many. What are the facts regarding the mineral wealth of the Isthmus?

#### B. PLACER DEPOSITS.

In many of the streams within the Canal Zone "colors" of gold can be obtained by washing the gravel. So far, however, no placer deposit of any value is known; and there is no indication that any such deposit may be discovered within the Zone. This unpromising outlook for placer values is due to the fact that the streams which show a few

colors have no gravel deposits worth mentioning, and the few streams that have considerable gravel are almost barren of colors. Some placer gold deposits, so called, were reported to the chairman. These on investigation proved to have not the slightest commercial value, in spite of the fact that they showed some "colors" of gold. In some other instances of reported placer deposits the "colors" were found to be not gold but yellow flakes of mica, with occasional crystals of iron pyrite.

Within the Republic of Panama, outside the Canal Zone, there are some placer deposits that may have commercial value.

#### C. LODE DEPOSITS.

Locally there are some indications of gold lode mineralization, but so far no lode deposit of commercial value is known within the Canal Zone. In the excavation of Culebra Cut some local areas of mineralization were encountered. These, however, proved to be scattered pyrite deposits in clayey shale near its contact with basaltic masses. Such deposits are due to the hot lava rock—the basalt—having been injected into the shale, and having given off mineralizing hot waters from which the pyrite, chalcedony, calcite, and some other minerals were precipitated as the whole cooled. Such deposits sometimes carry values in gold. These, however, are too local and not concentrated enough to have any commercial value. In at least one case within the Canal Zone some mining machinery was brought in. The wheels and well-turned shafts of this, however, have for some years served no other purpose than to afford roosts for the feathery tribe of the jungle.

Within the Republic of Panama, outside the Canal Zone, lode deposits of gold have been worked for many, many years, but the present output is very small, indeed. The Provinces of Darien, Los Santos, and Veraguas may show some mining development in the next few years, especially as some areas of volcanic rock there are known to carry native copper.

#### D. NONMETALLIC DEPOSITS.

(a) *Quarries and gravel pits.*—In construction work the commission has made use of seven different types of rock material, as follows:

1. Hard, tough crystalized (igneous) rock, broken so as to pass through a 3 to 4 inch round-hole screen. Vast quantities of this were used to mix with cement for the concrete work of the locks. The call for this type of rock is now practically over.

2. A considerable amount of fine screenings (inch mesh) were used for light concrete work, road work, local railway ballast, etc.

3. Great pieces of hard, tough igneous rock up to several tons in weight were used to armor the west breakwater, Colon Harbor, against the destructive effects of ocean waves.

4. Fill material of all kinds, mostly soft rock dug out of Culebra Cut, was used to fill in swamps, build up "made land," where necessary, to form a large part of Gatun Dam, and to heart or form the core of breakwaters.

5. Soft mud dredged out of canal channels or from borrow pits was pumped in to fill up certain swamp areas and to penetrate the interstices and fill all the spaces between the coarse fragments of Gatun Dam, thus creating a seal to insure water tightness.

6. Clean sand, free from organic matter, was used for concrete and other work.

7. Gravel was used for railway ballast and locally for concrete and other work.

Nature supplied the Canal Zone with some excellent sources from which to obtain rock for concrete work. The best of these is Ancon Hill, which furnished the crushed rock for the concrete work of the Miraflores and Pedro Miguel Locks. It consists of a dike of rhyolite nearly half a mile long and some hundreds of feet thick (plate 72). This rock is quite hard, so it resisted erosion, or wearing down, by the several streams which cut away the softer rocks around it. Because of this hardness Ancon Hill now stands over 600 feet above the river-flat lands which nearly surround it. The rock from this hill is very much broken up and very easily blasted out; so much so that relatively little further crushing by machinery is necessary to prepare it for use in concrete or other work. This broken-up condition is due to two causes: (a) On cooling from its original lava condition the rock developed joints or shrinkage cracks. (b) During the period of faulting, which cracked and sheared many of the rock formations on the Isthmus, this large tabular-shaped mass was considerably crushed and broken. In this case, the faulting or breaking of earth blocks in millineums ago has been an aid in canal construction. The same period of faulting, however, has been a hindrance in the excavation of Culebra Cut, for it locally weakened the rocks there and gave them a greatly increased tendency to slide.

The Porto Bello quarry and crushing plant furnished the crushed rock for the Gatun Locks. This quarry is located on a large area of andesitic rock, which had few shrinkage joints, and which was too large and solid to be much broken up by faulting. Here nature rendered but little assistance in crushing the material and getting it ready for lock building; so the canal commission had to have, relatively speaking, extra crushing done on this rock at extra cost. This quarry did good service in furnishing large pieces up to several tons in weight, which were used to armor the west breakwater at Colon Harbor.

In June, 1913, the commission wished to find a hard-rock quarry that should be as convenient as possible to Colon and to the relocated line of the Panama Railroad. Hard rock on the Canal Zone always stands up, forming ridges or hills. One of these ridges, 2 miles south of New Frijoles, was located from a railroad train. Then trails were cut in to it and a few small strippings made. The rock proved to be basalt and was favorably reported on. Subsequent work showed that, like nearly all the basalt masses of the Canal Zone, it broke up into fairly small fragments. This, though very desirable for concrete or road work, would be of little service in armoring a breakwater against sea waves unless reinforced by large heavy pieces. Several other hard-rock areas were examined. They were all more or less sheared and jointed, and so would break out fairly small. They, thus, would not be well suited to ward off the attacks of heavy sea waves. Sosa Hill, close to the Pacific entrance, was found to be a fairly solid mass of andesitic rock, which had very few shear joints, and in which the shrinkage joints were far enough apart, so that the rock would blast out in large pieces up to some tons in weight, with a relatively small percentage of fine material. This, then, is the best source known within the Canal Zone of material for armoring against heavy sea waves.



The gravel for railway ballast and other purposes was obtained from the Chagres River near Gamboa Bridge. This is practically the only source of gravel within the Canal Zone. The lower Chagres contains too much alluvium, and the upper part is too rocky to furnish much gravel. The available deposits of it lie between these two zones, convenient to rail transportation. This deposit furnished most of the ballast for the relocated line of the Panama Railroad. The Canal Zone streams are not good gravel makers because—

1. They are too short and most of them head in ridges of hard rock, which affords them very few fragments of material which they can easily wear into rounded gravel form.

2. In the dry season the streams are mostly too feeble, with the exception of the Chagres, to roll stones along and grind them into rounded gravel.

3. In the wet season, after heavy rains, the streams become raging torrents, which sweep away into the Chagres or into the ocean material which might have been a source of gravel.

4. The majority of the rocks traversed by Isthmian streams are easily disintegrated into fine clay. This forms a large proportion of the material carried by the streams, and it covers up and obscures much of the small amount of gravel that the streams manufacture.

(b) *Clay deposits*.—It was thought that tiles for various purposes in connection with canal construction work might be manufactured on the Isthmus cheaper than they could be imported. With this idea in view many samples of clays and clay rocks were sent to the States to be tested. The results were not favorable, as the baked and finished product was in all cases somewhat too brittle for use. Some of these clays would, it is believed, be quite good enough for brick, but so far no deposit of any importance that would make good tile has been found.

(c) *Limestone*.—Several inquiries have been received, mostly from persons not connected with the canal commission, as to whether limestone suitable for burning into lime is available on the Isthmus. In answer, it may be said that there are some limestone deposits quite close to the Panama Railroad that seem to be quite pure enough to make good lime. So far the commission has not found it necessary to have analyses of these made, but the hand specimens indicate that the material would very likely burn into a very good product. The cheapness with which this material could be quarried and loaded on cars with steam shovels adds to its prospective value as a local source of lime.

(d) *Fuller's earth*.—Within the Canal Zone are some large deposits of fuller's earth. Preliminary tests indicate that locally, at least, it is of fairly good grade. At this writing returns have not been received from several samples sent out for more extended examination. This is one of the reasons why a more detailed description of this interesting deposit is not written at this time.

(e) *Amber*.—In some local excavation work near Brazos Brook Reservoir, Mr. Fletcher Stevens found some amber. This material is a fossil resin. It was found some feet below ground in the weathered part of the Gatun formation. Whether it was deposited there from Oligocene trees when the Gatun formation was being formed or was introduced into the upper surface of this formation through the roots

of relatively recent trees the evidence is not clear, but it favors the latter idea. Tests showed that the material is not of sufficiently good quality to have much value in the arts. This fact, coupled with the relative scarcity or leanness of the deposit, renders this occurrence of amber of no commercial value.

(f) *Chalcedony*.—Uncrystallized quartz, chalcedony, in several shades of coloring is plentiful in many of the streams. Translucent varieties of it fill some cavities in the basalts of certain parts of Culebra Cut. A great deal of this material has been shipped to the States by souvenir collectors and cut into ornamental stones for jewelry, etc. It takes on a good polish, and while practically of no value as precious stones, these, when cut, are pretty souvenirs of the canal. Recently a considerable local traffic in these has sprung up.

(g) *Other minerals*.—In the streams, and locally, where rain has washed some of the clay rocks black sand remains behind as a concentrate. This is mostly magnetite, an oxide of iron which is magnetic. Ilmenite, an iron oxide, which contains some titanium, is present in small quantity. A few fine brassy crystals of pyrite also occur.

(h) *Mineral springs*.—The canal cut, below Miraflores Locks, uncovered a carbonated spring of somewhat astringent and saline taste. No analysis of the water has thus far been made.

Several hot sulphur springs are known in Panama outside the Canal Zone. One, claimed to have medicinal qualities, occurs within 2 miles of David, in the Province of Chiriqui.

#### E. FUELS.

(a) *Coal*.—The owners of certain condemned lands near Miraflores claimed that their property contained valuable deposits of coal. Examination proved that the so-called coal was nothing more than local lenses and beds of lignitic shale. Similar lignitic shale beds are exposed in several places in Culebra Cut.

The lignite so far known within the Canal Zone has no commercial value. It is practically certain that no valuable coal deposits will be discovered within the Zone, for the following reasons:

(1) All the lignites so far known are entirely too low in grade for fuel purposes.

(2) The beds are too thin—6 inches to 4 feet—and are locally discontinuous.

(3) The bedded rocks of the Canal Zone—those in which it is possible for coal to occur—are so weak and friable that mine openings in them would cave in unless timbering and reinforcing that would be excessive in cost were resorted to. Therefore, even if valuable coal deposits were discovered in such rocks they could not be mined as cheaply as coal can now be imported.

Two analyses of the Culebra Cut lignitic shales were made by the Bureau of Mines, with the following results:

	Sample No. 1.	Sample No. 2.
	<i>Per cent.</i>	<i>Per cent.</i>
Moisture.....	7.32	8.94
Volatile matter.....	24.03	29.14
Fixed carbon.....	20.33	28.89
Ash.....	48.32	33.03

Ultimate analysis showed that the samples contained sulphur as follows: No. 1, 7.52 per cent; No. 2, 4.34 per cent. From these analyses it is evident that the ash in both these samples is entirely too high to class them as fuels. Under very favorable conditions of mining this material might be used for the manufacture of producer gas. So far as known at present such favorable mining conditions do not exist.

(b) *Oil*.—Oil seepages within the Canal Zone and within the Republic of Panama have been reported. This matter was looked into with considerable care because a plentiful supply of relatively cheap fuel will be necessary to the best interests of the canal. The so-called oil seepages within the Canal Zone were found to be oillike films, resulting from decayed vegetation, which covered certain local pools of stagnant water. These, of course, have no relation to oil deposits.

An agreement was entered into between the canal commission, the Smithsonian Institution, and the Geological Survey for the purpose of gathering definite data on the general geology and on the occurrence of fuels, especially fuel oils, in Panama, outside the Canal Zone. The commission geologist was detailed to make such investigations as would not interfere materially with his duties on the Canal Zone. The Smithsonian Institution paid the expenses of the investigation, except the salary of the geologist. The Geological Survey is to make reports on the fossils collected and make chemical analysis of the typical rocks, etc. Much general geologic and geographic data that can not be given here, but will later be published by the Smithsonian Institution, were obtained.

Only one oil seepage, near Chorchá, was noted. Whether this will have commercial value or not is quite impossible to predict until some development work shall have been done on it. Other so-called oil seepages were visited, but these were merely oillike films from decayed vegetation that showed in places on the surface of some pools of stagnant water. Good oil seepages are reported from Darien, but have not yet been investigated.

(c) *Gas*.—Locally, in Culebra Cut, considerable gas escapes. It bubbles up here and there through pools of water, drainage ditches, etc. It is inflammable, and is what is currently referred to as natural gas. It is entirely too small in amount, and too localized to have commercial value.

(d) *Peat*.—No actual deposits of peat are known on the Isthmus. There is some little indication, however, that some of the swamps may contain peat deposits that might have some local value as sources of fuel.

(e) *Conclusion*.—There seems to be no doubt that the operation of the canal will call into being a fuel market of great importance. A good supply of relatively cheap fuel will therefore be a most important factor in the successful operation of the canal. It is gratifying, then, to have recent information from reliable sources of important oil seepages in Darien, Panama, in Ecuador, Venezuela, and to some extent in Colombia. Also to learn of a very large and high-grade coal deposit in Venezuela. Thus it seems practically certain that the canal will be quite conveniently situated to several sources of cheap fuel.

## F. LAND CLASSIFICATION WORK.

Many claims have been filed with the Joint Land Commission against the United States. In some of these it is stated that certain lands which will be flooded by the rise of Gatun Lake, or which are necessary for canal purposes, have a high value because of the mineral they contain. Coal was alleged to be the mineral which gave extra value to one tract. On examination this proved to contain nothing but some small lenses of lignitic shale of absolutely no commercial value. Other claimants assert that certain lands have valuable gold deposits. All these claims will be gone into with care and exactness and detailed reports on them will be made, through the chairman and chief engineer, to the Joint Land Commission, so that their mineral value or worthlessness may be clearly established.

## G. SLIDES.

In the geologist's report for the last year, page 205, Annual Report of the Isthmian Canal Commission, 1912, the slides of Culebra Cut were discussed at length. Since then some new data has become available and this will be incorporated in the brief discussion of the slides which follows.

Four distinct types of sliding ground have been recognized. These are—

- (1) Structural breaks and rock deformations resulting in slides.
- (2) Normal or gravity slides.
- (3) Fault zone slides.
- (4) Surface erosion.

Structural breaks give rise to the largest and most troublesome slides. They are due to very slow, flowage-like motion toward the canal of great masses of relatively soft rock. They do not occur except where the cut has attained a depth of over 125 feet, where the rocks are friable and easily crushed and deformed. There is only one remedy for this type of slide, and that is to make the walls of the excavation less steep, so that the unbalanced pressure at the foot of the slope will not exceed the crushing and deforming strength of the rock there. This lightening up should anticipate deforming movements, for such movements greatly weaken the slopes so that after deformation they will stand only at a much flatter angle than would have been required before deformation began. Early lightening up, therefore, saves much, not only in the final yardage output, but in track shifting, drainage, and transportation as well.

The normal or gravity slides are those where loose masses of earth and rock slip off comparatively solid foundations into the excavation. For such slides there is practically no remedy, except that they are retarded somewhat by good drainage. These slides do not weaken the slopes as the break deformation slides do. While troublesome at the time, they have no bad after effects. For this reason no saving of excavation can ordinarily be accomplished by removing material from their upper slopes. It is better to let them run their course and shovel them out from the bottom of the cut.

The third type of slide is that occasioned primarily by the weakening effects of sheared fault zones, which cut diagonally across the canal prism. The mass of rock, in the acute angle which the fault plane makes with the slope of the excavation, has sometimes a large

overhang due to the dip of the fault. This overhanging part rests insecurely against the rocks from which it has been faulted off, thus throwing an additional strain on the narrow base of the fault block. If this base fails, a fault zone slide results. The only remedy for these faults is to make the slope relatively flat in the vicinity of fault zones where there is an overhang of the fault block, due to the dip of the fault plane. The fault zone type of slide differs from the others in that it occurs in rocks perfectly strong enough to stand at a steep angle but for the weakening presence of the fault. Slides of this character are not common and are not now relatively important.

The fourth type of sliding ground is that due to the wash of the heavy tropical rains. These rains wash and trench the unprotected slopes of Culebra Cut, and carry down a vast lot of material in the course of a year. The remedy for this is provided by nature, and consists in assisting grasses and vegetation to clothe the slopes. Of course such a vegetable growth would have no effect on ordinary slides, but it will minimize the wash and erosion of the slopes by heavy tropical rains.

In the last report it was predicted that several million cubic yards of slide material would yet come in before the slide period closed, but that there could be no doubt whatever that sliding would cease after a time, when the slopes had become flat enough. Since then, all the evidence has been in confirmation of this. The only slide which let down more material than was expected from it was the Cucaracha. Several basaltic dikes had held this back for almost a year, and it was thought that they were strong enough to hold it entirely. Finally the pressure got so great that the dikes were sheared off and material considerably in excess of a million cubic yards, more than twice as much as was expected from this slide, began to move. Now that the cut in front of this slide is down to final depth it seems fairly certain that this slide is on its last stage of serious activity. This statement is prompted chiefly by the knowledge that the basalt dikes, the tops of which were sheared off causing renewed activity of the slide, are in place below the present moving ground, and will limit the amount of material that can move here in the future. Under ordinary conditions these dikes would have held back the present Cucaracha slide movement entirely, but for the fact that excessive jointing, developed by cooling and fault movements, had rendered them weaker than their size indicated. In fact, most of the basaltic rocks on the Isthmus are highly jointed and weakened, as explained under the heading of Quarries. On the whole, while the slides have been very troublesome and are not yet finished, it is quite certain that they will give no trouble to the completed canal, unless they may happen to cause some little inconvenience during the first year or two of operation. A few of the periodicals, especially some of the European shipping journals, have not yet been able to divorce themselves from the opinion that ships going through the canal are liable to destruction from slides, earthquakes, budding volcanoes, or other catastrophical calamities, perhaps not even excluding demolition by sea serpents. To those who know the conditions on the ground all this seems a drifting off into the realms of fancy, unworthy of present day information. Ships going through the Panama Canal will be subject to no more danger than they would be in any other large canal.

## PLATE 123. GEOLOGICAL CROSS SECTIONS OF CULEBRA CUT.

In explanation of the geological cross sections shown on plate 123 it may be said: The left-hand end of each section represents the eastern side of the canal and the right-hand end the western side. The center line from which the cross sections are measured is the center line of the old French sea-level canal. It is 80 feet east of the present actual center line, but is still retained because much cross-section work had been done before the American plans called for a widening of the canal on the westerly side. The original surface of the ground is shown in dotted lines. The surface when the Americans began excavation work March 1, 1906, is shown in broken lines. The bottom of the canal is shown in heavy lines. The amount still to be excavated shows as rock in place above the bottom lines. The boundaries of the different rock formations before excavation are shown as broken lines projected into the cut.

The upper cross section, that at station 1743 plus 50, shows the overlying soft volcanic clay rock on the right-hand (west) side which slid off the slightly canalward sloping tuff and limy sandstone beds. This material came down as a normal slide; when an average slope of about 1 on 5, or about 11.5 degrees was attained, the slide came to rest.

The second cross section, that at station 1782, shows the remarkable fact that the unbalanced pressure created by the cut, which is over 270 feet deep here, developed a break or wide crack in the bank on the left-hand (west) side nearly 1,400 feet back from the toe of the slope; and a crack on the right-hand side nearly 1,000 feet back from the toe of the slope. In both cases slow deformation and canalward movement of the rocks have caused these breaks. On the east side a line through the apex of the crack and through the toe of the slope would make an angle of about  $10^{\circ}$  with the horizontal, and on the other side a similarly placed line would make an angle of about  $15^{\circ}$ . However, these cracks, being about perpendicular and probably 50 feet or more deep, are evidence that deformations in a sort of flowage way to depths below the excavation have gone on, and that such deformations can not well be measured in terms of angles. Some bulging up in the bottom of the cut has occurred here at times.

The cross section at station 1797 shows the relative steepness of slopes where the rocks are basalts and metashale, as at Gold Hill.

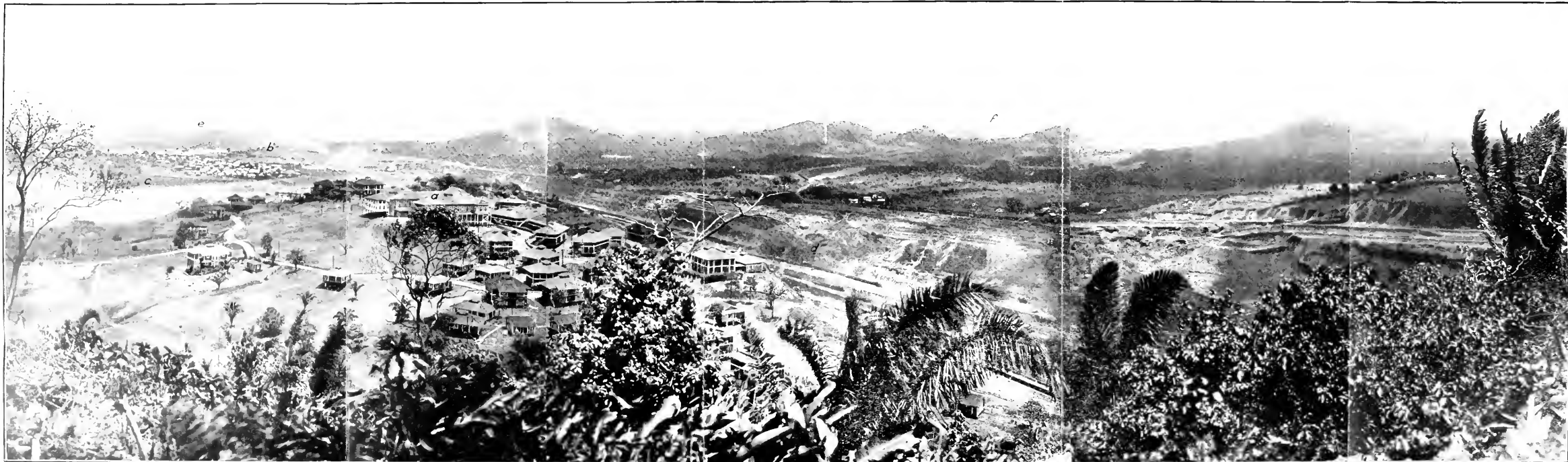
The two lower cross sections at stations 1809 and 1812 plus 50 are to show the flatness of the Cucaracha slide on the east side and the relative steepness of Contractors Hill on the west side. Cucaracha slide has been active since French days and has let down several million cubic yards of material altogether. The average slope of this slide is about 1 on 5, but locally it is flatter than this. The basalt dikes shown in the cross section have held back the sliding material for considerable periods, but as the cut in front became deeper the pressure increased until the tops of the dikes were sheared off, and the accumulated slide material let into the cut. The cut is now almost down to grade in front of this slide, so it has reached its last serious stage of activity.



HILL TYPE OF THE MOUNTAINS LOOKING SOUTHWARD AND SOUTHEASTWARD FROM ZION (RESERVATION) HILL, CULEBRA.  
 a, Gold Hill b, Contractors Hill c, Arzon Hill d, Culebra Cut



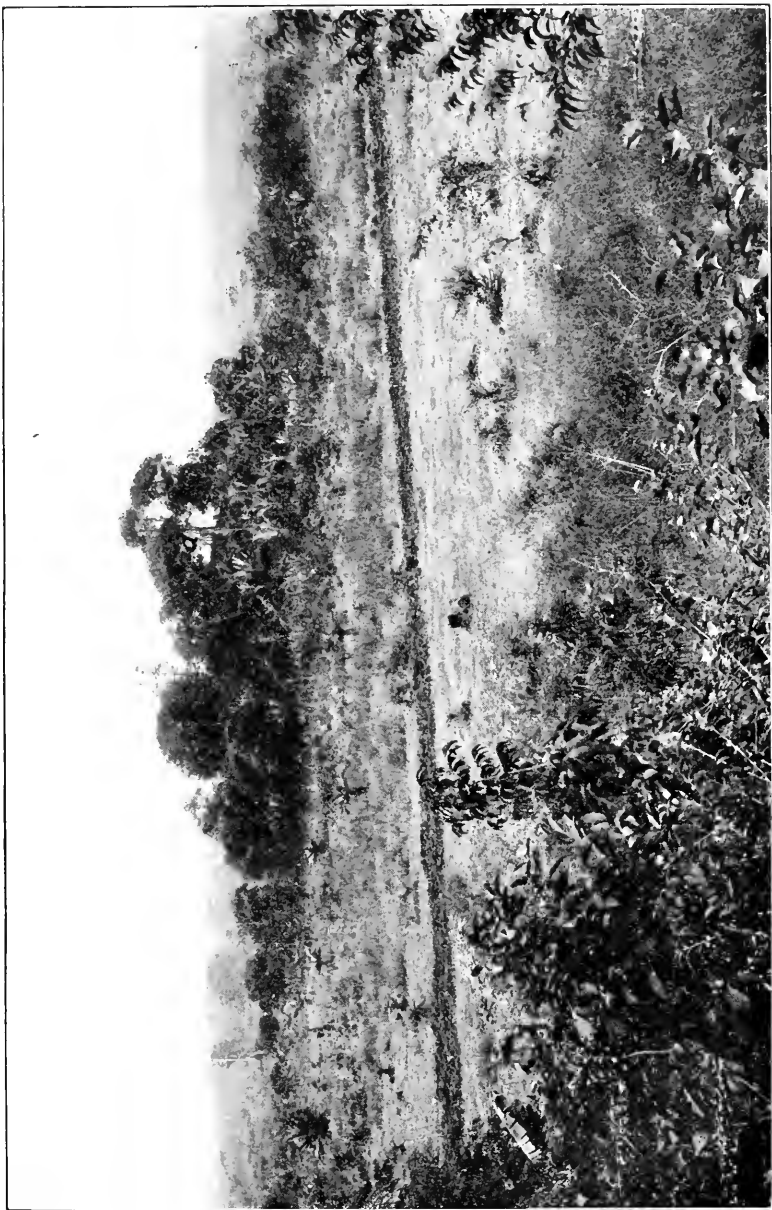




HILL TYPE AT GRAFIS, LOOKING NORTHWARD AND NORTHEASTWARD FROM ZION HILL, CEBU

1. The hill on the left is the highest point of the island. 2. The hill on the right is the highest point of the island. 3. The hill in the center is the highest point of the island. 4. The hill on the left is the highest point of the island. 5. The hill on the right is the highest point of the island. 6. The hill in the center is the highest point of the island.



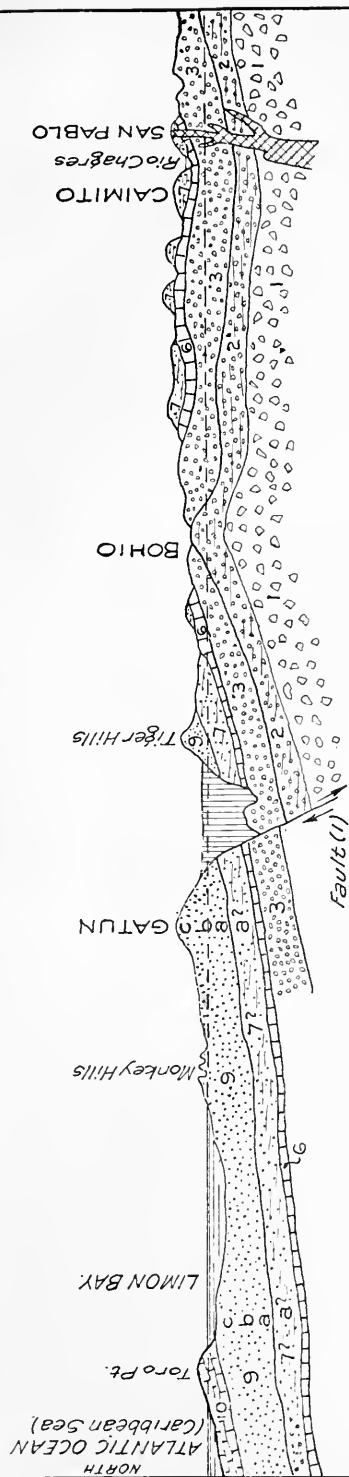


# COASTAL PLAIN TYPE OF TOPOGRAPHY.

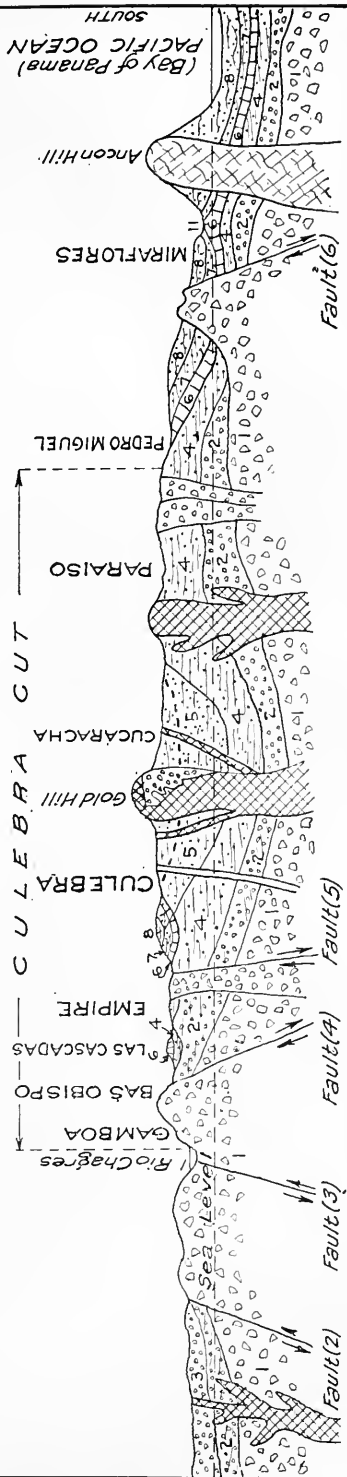
Flat lands near Mount Hope, with some small knolls, or rounded hills, rising 10 to 50 feet above the general low flat surface of the plain. This group of small knolls here has been called the Monkey Hills (Plate 68). They are remnants of a higher land surface; the interhill areas having been washed away by stream erosion when the Isthmian land stood some hundreds of feet higher than now. *a*, A knoll rising about 30 feet above the surrounding plain.



# GENERALIZED GEOLOGIC SECTION



# ACROSS THE ISTHMUS OF PANAMA



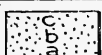
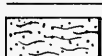
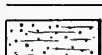
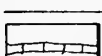
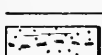
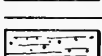
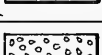
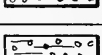
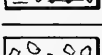
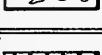


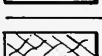
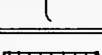

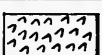


RELATIVE POSITIONS OF THE ROCKS ACROSS THE ISTHMUS.



# GENERALIZED SECTION

## CANAL ZONE FORMATIONS.

OLIGOCENE PERIOD	LATE PLEISTOCENE		11	Pleistocene Formations	{ c - River alluvium b - Muds and Silts a - Gravel
	PLEISTOCENE OR PLOIOCENE		10	Caribbean Limestone	{ Shell and Marl Limestone
			9	Gatun Formation	{ c - Clay beds b - Fine sandstone a - Argillite
			8	Panama Formation	{ Light colored tuff beds, Argillite, etc.
			7	Caimito Formation	{ c - Sandstone b - Limy conglomerate a - Sandstone
			6	Emperador Limestone	{ Marine limestone Many corals
			5	Cucaracha Formation	{ Land formed clay, rocks, etc. Lava flow.
			4	Culebra Formation	{ Marine carb., shale, clay, tuffs, sandstone.
	OLIGO-CENE (?)		3	Bohio Conglomerate	{ Sand, gravel, boulders, etc. deposited in water.
			2	Las Cascadas Agglomerate	{ Volcanic ash, mud, lava and lava flows.
			1	Bas Obispo Formation	{ Volcanic breccia
MIOCENE (?) (Mostly)			6	Basalt	
			5	Meta-breccia	
			4	Rhyolite	
			3	Andesite	
			3	Andesite	
			2	Diorite	
			1	Granodiorite	

SHOWS THE ROCK SUCCESSION, THE NUMBER OF DIFFERENT FORMATIONS, ETC.

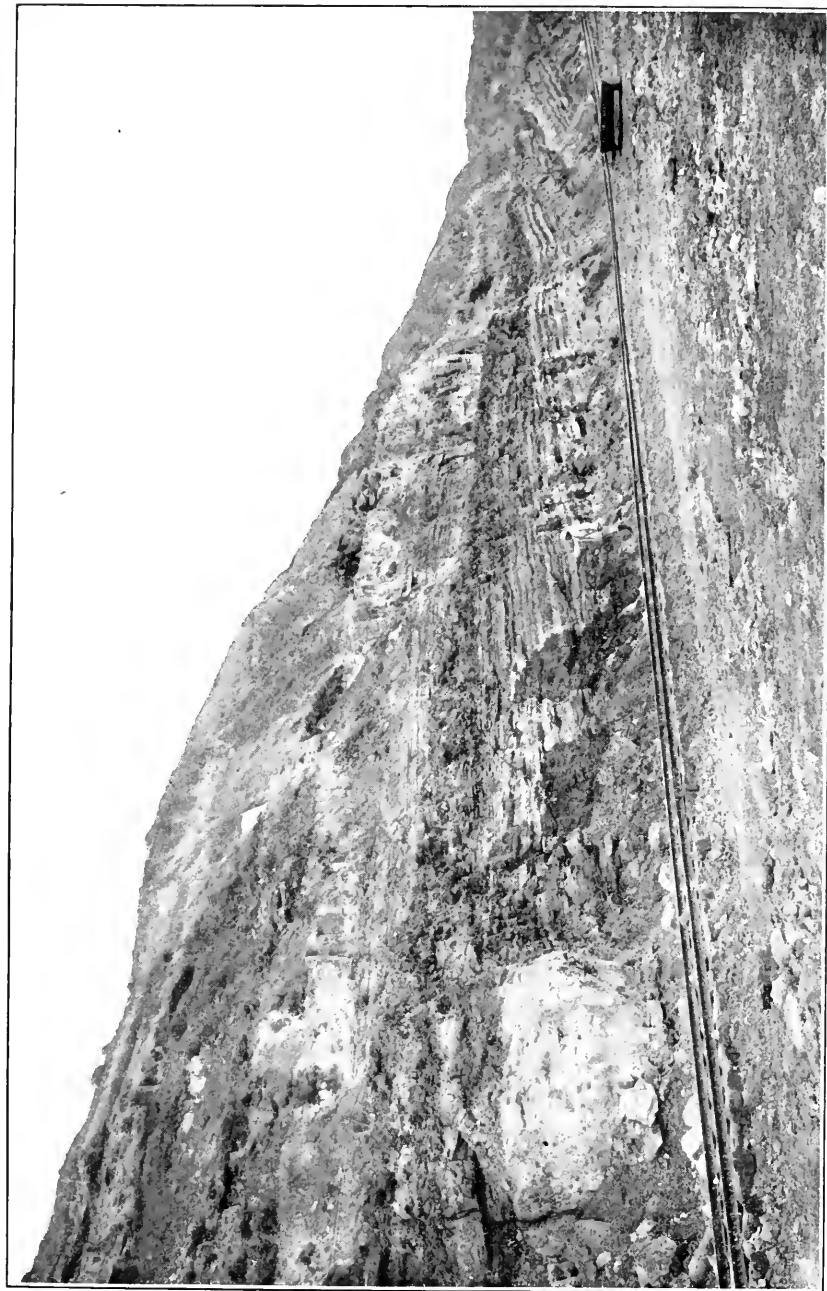






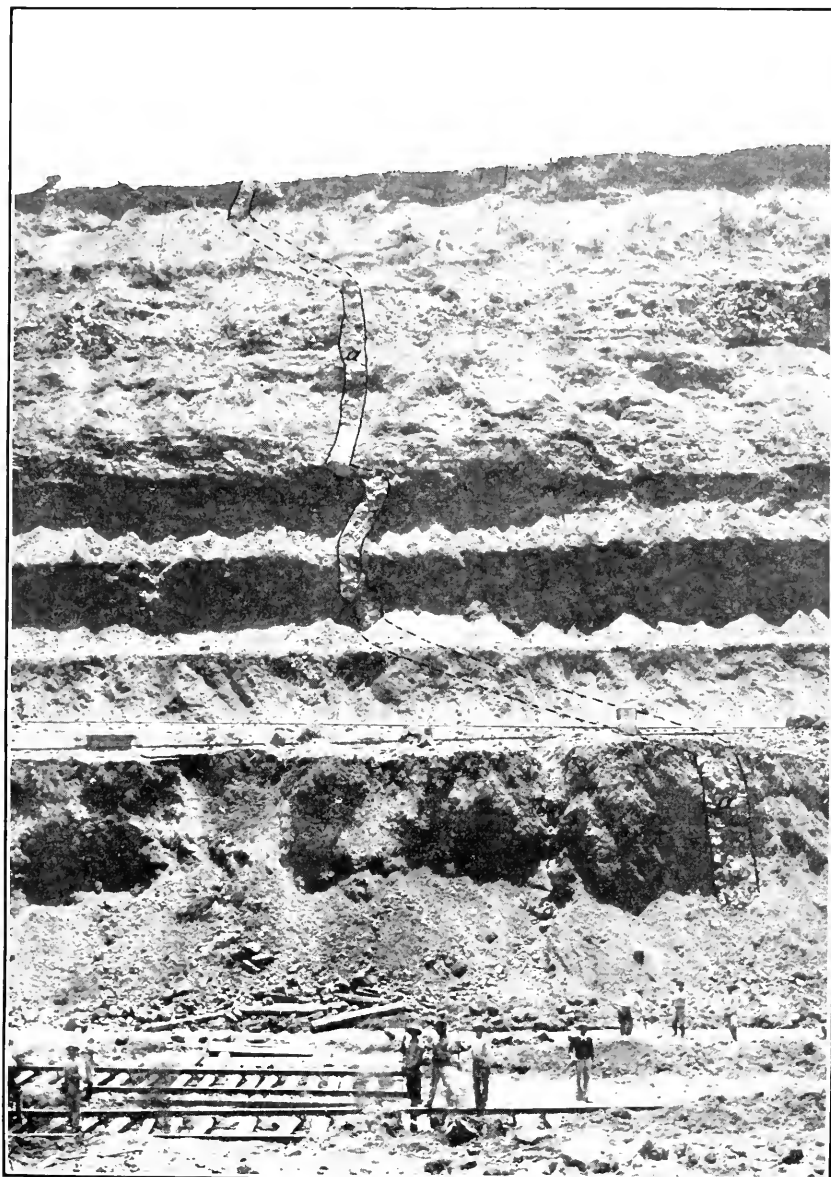
SHOWS CHARACTER OF VOLCANIC AGGLOMERATE MATERIAL EJECTED BY EXPLOSIVE OUTBURSTS FROM ANCIENT VOLCANOES THAT HAVE LONG SINCE CEASED TO EXIST.





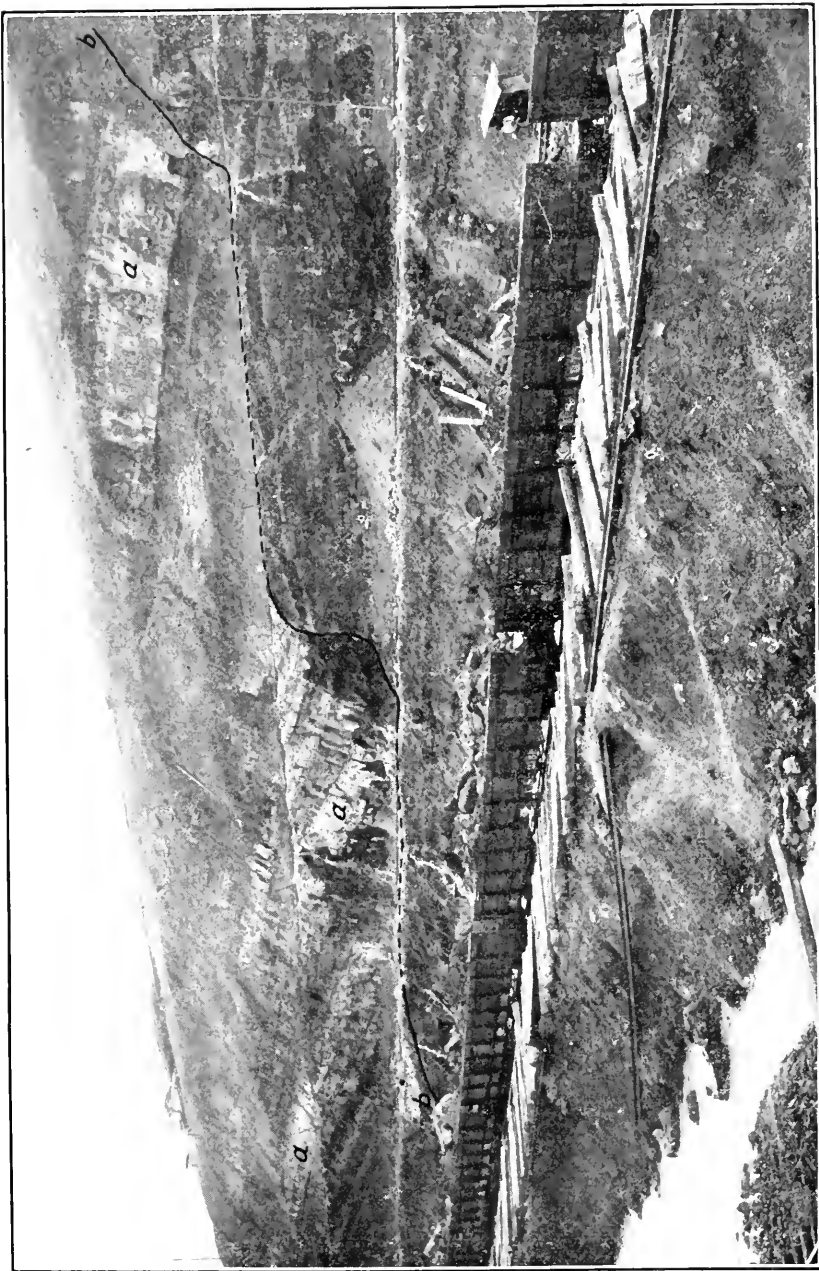
SHOWS BEDDED CHARACTER OF THE UPPER PART OF THE CULEBRA FORMATION; THIN SANDY LIMESTONE BEDS SEPARATED BY PARTINGS OF DARK CARBONACEOUS CLAY AND SHALE. THESE BEDS CONTAIN THE REMAINS OF OYSTERS, CORALS, AND OTHER MARINE ANIMALS.





*a*, DIKE OF BASALTIC ROCK WHICH CUTS THROUGH THE CUCARACHA FORMATION, OPPOSITE CULEBRA. SINCE IT WAS FORMED THIS DIKE HAS BEEN BROKEN AND JOGGED BY FAULTING AND SHEARING. *b*, OLD LAVA FLOW IN CUCARACHA FORMATION.

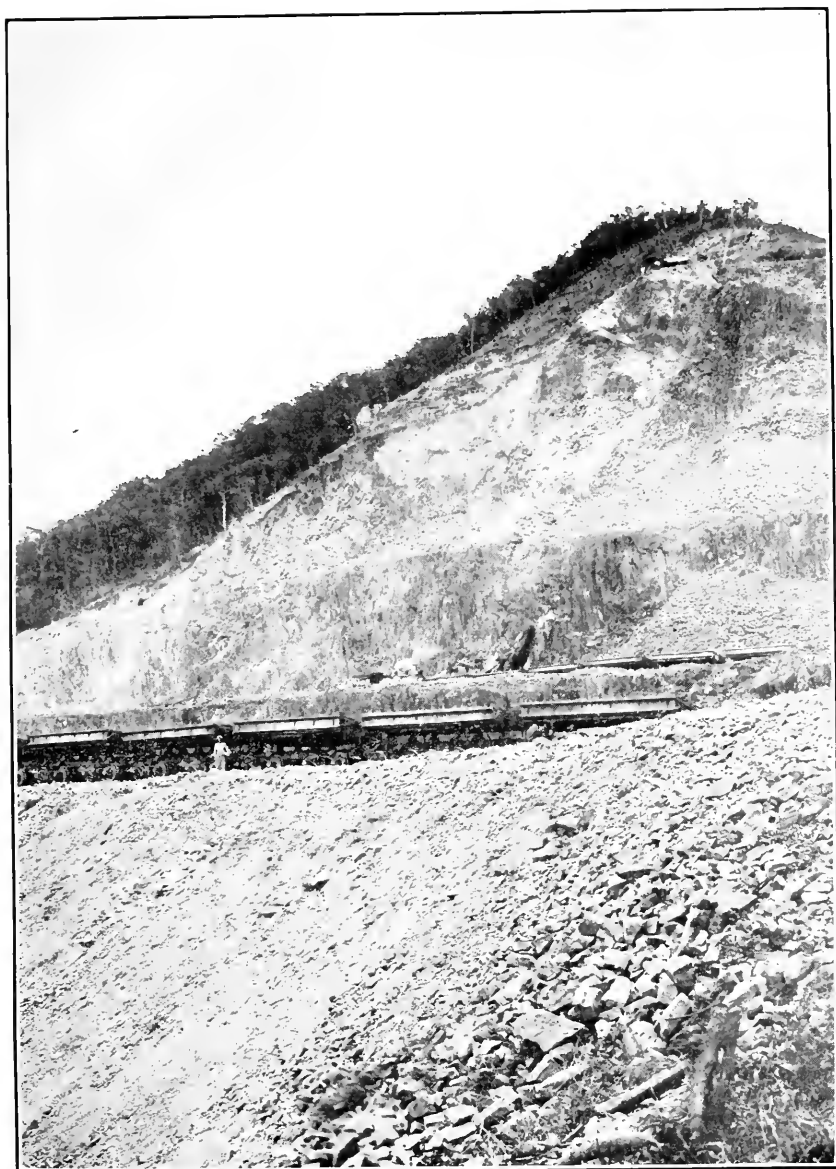




*a*, LIMESTONE BEDS NEAR LAS CASCADAS. THESE LIMESTONES SHOW THE REMAINS OF MANY SEA ANIMALS, ESPECIALLY OF CORALS. *b*, LARGE FAULT WHICH CUT OFF THE LIMESTONE BEDS HERE.

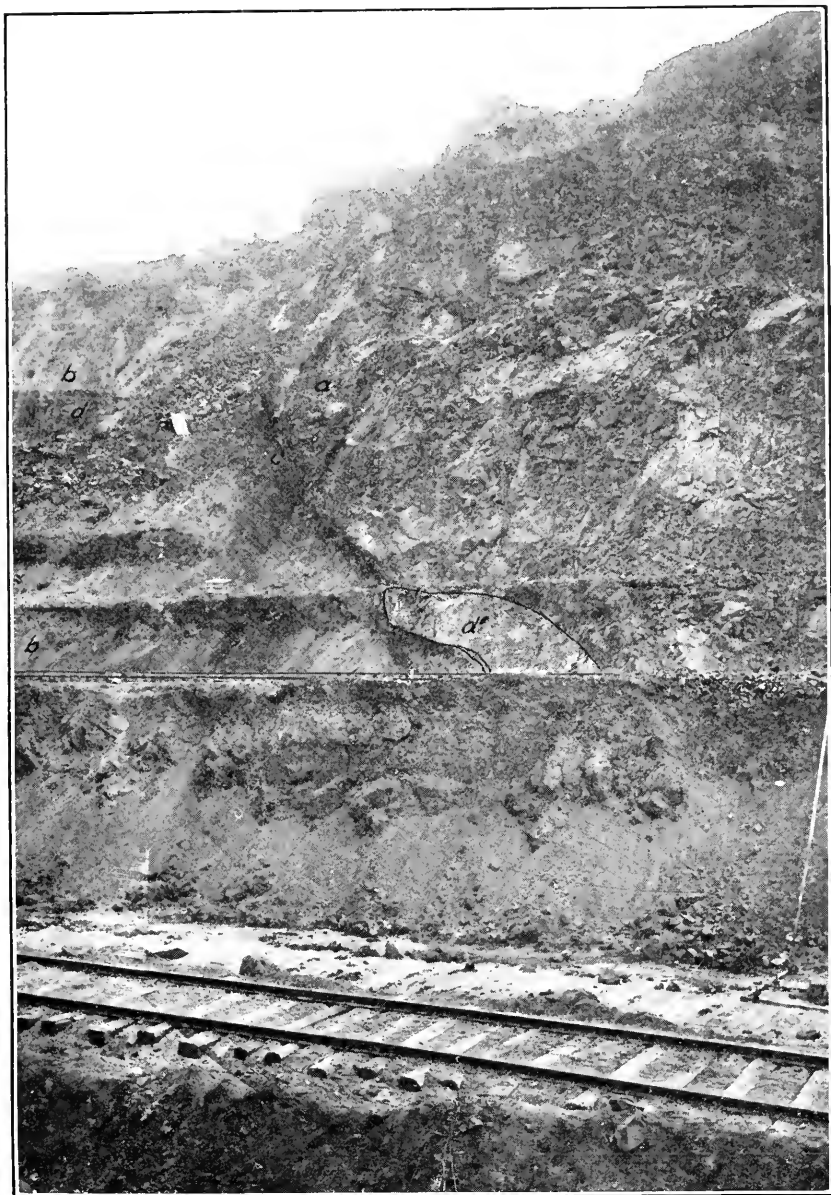






ANCON QUARRY, ON THE SOUTHWEST END OF ANCON HILL.





*a*, NORTHERLY EDGE OF GOLD HILL MASS, PART OF THE BASALT DIKE WHICH FORMS THE NORTHERLY AND WESTERLY PERIPHERY OF THIS HILL. *b*, CUCARACHA FORMATION. *c*, FAULT ZONE, WHICH EXTENDS AROUND HILL MASS. *d*, OLD LAVA FLOW. *d'*, MASS OF OLD LAVA PULLED DOWN FROM *d* (OVER 100 FEET) BY FRICTIONAL DRAG OF HILL MASS, AS IT WAS FAULTED DOWNWARD IN LATE GEOLOGIC TIMES.





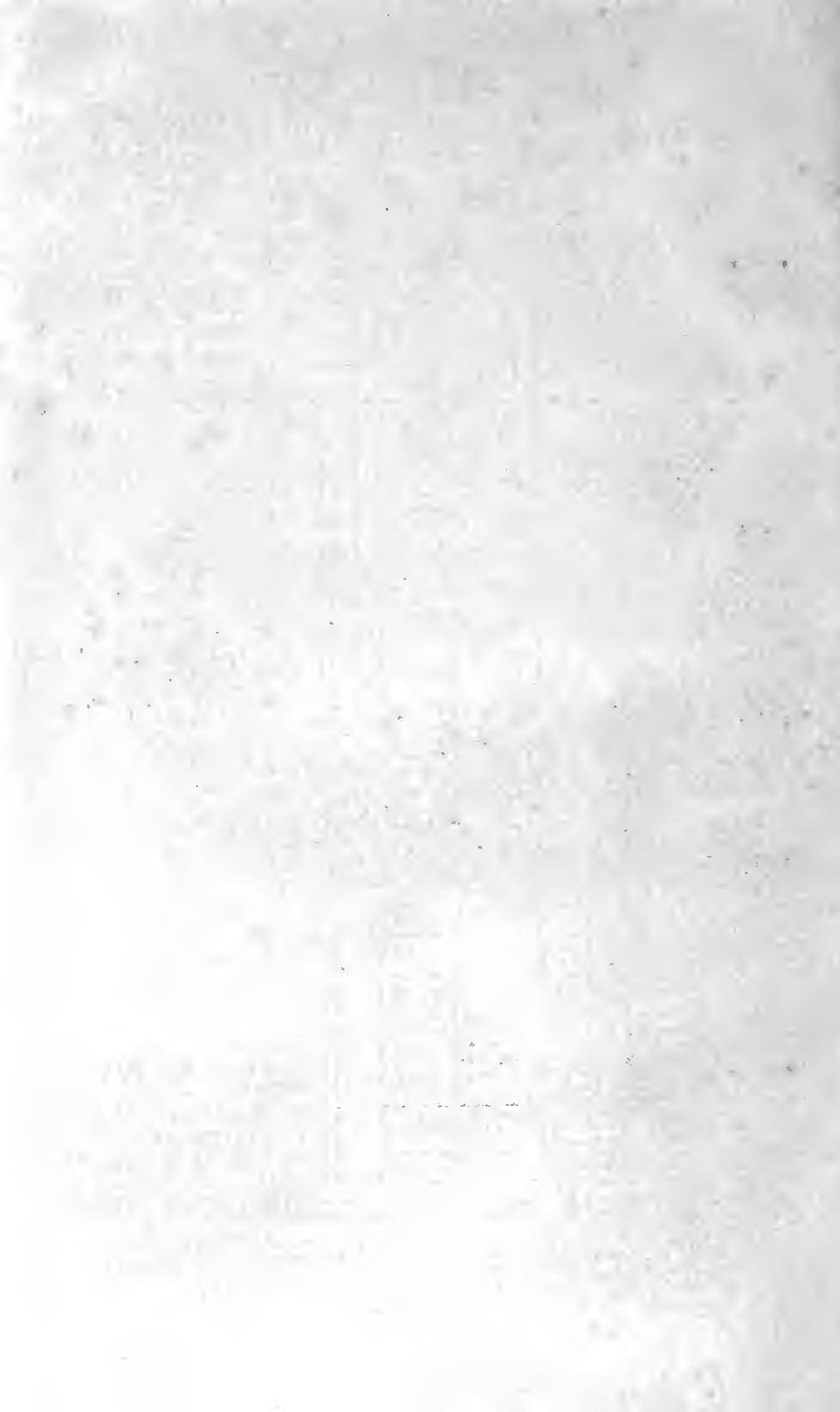
a, CONTRACTORS HILL MASS, WHICH SEEMS TO BE SURROUNDED BY THE FAULT PLANE b; THE MOTION OF THE HILL MASS WAS DOWNWARD, AS SHOWN BY THE PROTECTED LITTLE AREAS OF SOFTER MATRIX BEHIND (ABOVE) THE HARD BASALTIC FRAGMENTS IN THE HILL MASS, AS SHOWN AT c. THE SHEARED ZONE d IS HERE OVER 10 FEET WIDE.





c, FAULT PLANE ON WEST SIDE OF CULEBRA CUT JUST SOUTH OF LAS CASCADAS.

The earth adjustments which caused this, and similar breaks or faults, took place thousands of years ago. The rocks on the right of *c* dropped downward about 45 feet, as shown by the fact that *a'* is a continuation of the lava flow *a*, *b'* of *b*, and so on. A minor break or fault plane is shown at *d*. This fault cuts across the canal prism. On the opposite (east) side of the canal it was one of the chief factors which weakened the slope and caused the big fault zone slide about 600 feet north of La Pita. This slide involved the diversion and let down 300,000 cubic yards of rock material.





# APPENDIX T.

## TABLES SHOWING INCREASES IN SALARIES AUTHORIZED OVER ORGANIZATION OF JULY 1, 1910, AND INCREASES OF NUMBER OF PERSONS EMPLOYED OVER NUMBER ALLOWED IN 1913 BOOK OF ESTIMATES, AS REQUIRED BY ACT OF CONGRESS APPROVED AUGUST 24, 1912.

### DEPARTMENT OF CONSTRUCTION AND ENGINEERING.

Designation.	Increase in pay.		Increase in number.		Explanation.
	Rate authorized in organization of July 1, 1910.	Increased to—	Number authorized in 1913 Book of Estimates.	In-creased to—	
OFFICE OF CHIEF ENGINEER.					
FIRST DIVISION. <sup>1</sup>					
Blacksmith, \$1,591.20.....				1	
Blacksmith, \$1,370.88.....				1	
Carpenter, \$1,713.60.....				4	
Carpenter, \$1,591.20.....				8	
Carpenter, \$1,370.88.....				8	
Clerk, \$1,800.....			3	5	
Coxswain, \$1,140.....				1	
Draftsman, \$2,400.....			1	2	
Draftsman, \$2,100.....				4	
Draftsman, \$1,800.....			5	10	
Draftsman, \$1,500.....			3	4	
Draftsman (tracer), \$900.....				1	
Electrical and mechanical engineer.	\$7,500.00	\$9,000.00	1	1	Increase of pay of electrical and mechanical engineers account of increased responsibilities connected with the erection of machinery and electrical equipment.
Engineer, steam, \$1,800.....			10	11	
Engineer, steam, \$1,500.....				1	
Engineer, launch, \$1,140.....				1	
Erector, \$1,800.....				52	Erectors were originally shown on organization as machinists and changed to erectors, in order to give men a designation which was more in keeping with the work performed under the superintendent of erection.
Erector, \$1,680.....				11	
Erector, \$1,591.20.....				2	
Erector, \$1,370.88.....				10	
Erector, \$1,224.....				12	
Erector, \$1,077.12.....				19	
Erector, \$930.24.....				13	
Erector, \$783.36.....				18	
Erector, \$612.....				2	
Foreman, \$2,100.....			2	5	
Foreman, \$1,800.....			12	40	
Foreman, \$1,350.....				1	
Foreman, \$1,200.....			1	6	
Foreman, \$1,000.....				1	
Inspector, \$2,400.....				1	
Inspector, \$2,100.....				4	
Ironworker, \$1,591.20.....				4	
Ironworker, \$1,370.88.....				1	
Levelman, \$1,500.....			2	6	
Machinist, \$1,591.20.....				2	
Pipefitter, \$1,591.20.....				2	
Pipefitter, \$1,224.....				2	
Rodman, \$1,000.....			1	6	
Supervisor, \$3,000.....			5	6	Re-rated from superintendent at \$3,000.
Transitman, \$1,800.....			1	3	
Wireman, \$1,591.20.....			42	46	
Wireman, \$1,224.....				2	
Wireman, \$1,077.12.....				3	
Wireman, \$930.....				5	
Wireman, \$783.36.....				3	
Wireman, \$612.....				2	

<sup>1</sup> The increase in the number of employees at the various designations for the erection force of the first division, has been occasioned by new division of work between the construction divisions and the erection force of the first division.

By the new division of work, additional duties were assigned to the first division, involving an increase in expenditure for labor not estimated for by this division of approximately 45 per cent.

The increase in number of men is also due to advancing the date of completion and the delay in delivery of apparatus, thus requiring a shorter period in which to complete a fixed amount of work.

## DEPARTMENT OF CONSTRUCTION AND ENGINEERING—Continued.

Designation.	Increase in pay.		Increase in number.		Explanation.
	Rate authorized in organization of July 1, 1910.	Increased to—	Number authorized in 1913 Book of Estimates.	Increased to—	
OFFICE OF CHIEF ENGINEER—Continued.					
SECOND DIVISION. <sup>1</sup>					
Section of meteorology and hydrography: Hydrographer, \$1,800.			1	2	One additional hydrographer employed on gaging of streams from July 1, 1912, to Dec. 19, 1912, since which time position has remained unfilled. This position was in lieu of observer at \$1,200, estimated for but not used.
Section of surveys: Rodman. \$1,000.			1	6	The estimates were not suited to the work. The number of rodmen employed varied from two to a maximum of six during the latter part of the fiscal year when a large amount of field work was required for the land commission. The five additional positions of rodmen were authorized to conform to the class of work required, and in lieu of the following positions estimated for but not used: 1 transit man at \$2,100, 1 transit man at \$1,800, 3 levelmen at \$1,500.
Pacific terminal: <sup>2</sup> Plans for dry docks: Draftsman, 2,100.			2	3	One temporarily employed in latter part of June in order to enable plans for Dry Dock No. 2 to be prepared. Two positions of draftsmen at \$1,800 unfilled in the meantime.
Inspector, \$2,100.				2	Temporarily employed during May and June, 1913. These men will inspect in the United States the manufacturing of caisson for Dry Dock No. 2, during the fiscal year 1914, and were employed during May and June on the Isthmus in connection with the design in order to familiarize themselves with the work to be inspected. Two positions of draftsmen, one at \$2,400 and one at \$1,800, remained unfilled in the meantime.

<sup>1</sup> Includes former third division, abolished Jan. 24, 1912, and the Pacific terminals construction which was estimated for by the Pacific Division and work carried on under that Division until Dec. 12, 1912, when it was transferred to the second division.

<sup>2</sup> Estimated for by the second division.

When the estimates for the fiscal year 1913 were submitted, the plans for the terminals were yet in the preliminary stage. As the work progressed, it became necessary to temporarily increase the number of men over those authorized in the book of estimates, in order to provide for earlier completion. In this connection, attention is invited to sundry civil bill approved June 23, 1913, making appropriations for the Panama Canal for the fiscal year 1913-14, which contains the same limitations in regard to increases in number and in compensation as the sundry civil bill approved Aug. 24, 1912, covering the fiscal year 1912-13, with the following addition: " \* \* \* and except for those employed in connection with the construction of \* \* \* dry docks, repair shops, yards, docks, wharves, warehouses, storehouses, and other necessary facilities and appurtenances for the purpose of providing coal and other materials, labor, repairs, and supplies \* \* \*." Circumstances for the fiscal year 1913 were the same as they will be during the fiscal year 1914, i. e., when the estimates were submitted it was not possible to anticipate the actual requirements and additional force was temporarily employed as new work was authorized.

## DEPARTMENT OF CONSTRUCTION AND ENGINEERING—Continued.

Designation.	Increase in pay.		Increase in number.		Explanation.
	Rate authorized in organization of July 1, 1910.	Increased to—	Number authorized in 1913 Book of Estimates.	In-creased to—	
OFFICE OF CHIEF ENGINEER—Continued.					
SECOND DIVISION—contd.					
Plans for permanent shops: Mechanical engineer, \$3,300.				1	This position was authorized May 1, and is in lieu of position of mechanical engineer at the same rating abolished in the mechanical division organization on the same date. Incumbent temporarily employed on design of permanent shop buildings and also acts in an advisory and consulting capacity for the mechanical division whenever needed in connection with the work formerly required by that division of its mechanical engineer. Incumbent rated at \$3,000 from May 1, 1913.
Assistant engineer, \$3,000.				1	Temporarily employed on design and inspection of permanent shop buildings.
Draftsman, \$2,400.				1	
Draftsman, \$2,100.				3	
Draftsman, \$1,800.				3	
Draftsman, \$1,650.				3	
Draftsman, \$1,500.				4	
Inspector, \$2,100.				1	1 additional employed Dec. 9, 1912, account of increased work on shop buildings.
Inspector, \$1,800.				1	
Clerk, \$1,500.				1	
Pacific terminal construction: <sup>1</sup>					
Transitman, \$2,100.			1	2	Increase of 1 effective May 23, 1913, account of increased work on shop buildings.
Rodman, \$1,000.			2	3	1 additional, account of increased work on dumps and 1 additional account of increased work on shop buildings.
General foreman, \$2,100.			3	5	Increase, account of cutting in an additional shovel for borrow pit excavation in vicinity of Diablo Hill, not anticipated in estimate.
S. S. engineer, \$2,500.			5	6	Employed on estimates and profiles.
S. S. craneman, \$2,200.			5	6	
Draftsman, \$1,800.				1	Chairman's letter, Jan. 4, 1913. Chairman, May 10, 1913.
Draftsman, \$1,500.				1	
FIFTH DIVISION.					
I.—Officers and employees:					
Resident engineer.	\$6,000	\$6,600			Assistant engineer hydraulic excavation increased from \$250 to \$300 per month in making organization for Gold Hill work. General foreman and station engineer each reduced from \$225 to \$200 per month.
Resident engineer.	6,000	7,500			Chairman's letter, Mar. 28, 1913. New town site and administration building.
Assistant engineer.	3,000	3,600			Chairman's letter, Mar. 19, 1913. Pedro Miguel.
Junior engineer, \$2,400.			1	2	
Supervisor, \$3,000.			2	3	

<sup>1</sup> Estimated for by Pacific Division.

## DEPARTMENT OF CONSTRUCTION AND ENGINEERING—Continued.

Designation.	Increase in pay.		Increase in number.		Explanation.
	Rate authorized in organization of July 1, 1910.	Increased to—	Number authorized in 1913 Book of Estimates.	Increased to—	
OFFICE OF CHIEF ENGINEER—Continued.					
FIFTH DIVISION—continued.					
I. Officers and employees—Continued.					
Clerk, \$1,800.....			18	19	Chairman's letter, Oct. 30, 1912. To cover employment of E. R. King for 84 days vice R. Fulford discharged with 84 days leave to his credit. Inasmuch as Mr. King was transferred to a position which would probably not last as long as the one he had been occupying it was considered only fair to Mr. King that he receive full pay of position from the beginning.
Clerk, \$1,500.....			22	23	Chairman's letter, Oct. 10, 1912. For period of about 3 months during absence of clerks L. E. Herman and P. H. Chadbourne on annual vacations.
Clerk, \$1,200.....				1	Chairman's letter, Sept. 11, 1912. Temporary during absence on leave of R. P. Larrabee.
Clerk, \$1,200.....				2	Chairman's letter, Dec. 14, 1912. Temporary during absence of regular clerk on leave.
Despatcher, chief, \$2,700.....				1	Chairman's letter Jan. 21, 1913. Increased amount of transportation.
Foreman, general, dumps, \$2,400.....			13	14	Chairman's letter Jan. 27, 1913. Additional dumps and equipment on excavation.
Foreman, general, \$2,400.....			13	15	Chairman's letter Mar. 28, 1913. New townsite and administration building.
Foreman, \$1,800.....			163	167	Chairman's letter Mar. 28, 1913. New townsite and administration building.
Foreman, \$1,500.....			106	110	Chairman's letter Mar. 28, 1913. New townsite and administration building.
Transitman, \$2,100.....			5	6	Chairman's letter Mar. 28, 1913. New townsite and administration building.
Transitman, \$1,800.....			1	2	Chairman's letter Mar. 28, 1913. New townsite and administration building.
Yardmaster, \$2,520.....			3	4	Chairman's letter Jan. 27, 1913. Increased amount of transportation.
Yardmaster, \$2,280.....			3	6	Chairman's letter Sept. 13, 1912. Account changed plans and track systems on dry excavation.
Do.....			6	11	Chairman's letter Jan. 2, 1913. Account of additional equipment and 12-hour day on excavation; substitution of yardmasters at points previously handled by silver employees.
II. Skilled and unskilled labor:					
Artisans (various), \$1,617.20.....				10	Chairman's letter Feb. 26, 1913. Installation of Gold Hill hydraulic excavating plant.
Carpenter, \$1,617.20.....			93	95	Chairman's letter Feb. 15, 1913. 12-hour day on concrete.
Do.....			93	99	Chairman's letter Mar. 28, 1913. New townsite and administration building.

## DEPARTMENT OF CONSTRUCTION AND ENGINEERING—Continued.

Designation.	Increase in pay.		Increase in number.		Explanation.
	Rate authorized in organization of July 1, 1910.	Increased to—	Number authorized in 1913 Book of Estimates.	Increased to—	
OFFICE OF CHIEF ENGINEER—Continued.					
FIFTH DIVISION—contd.					
II. Skilled and unskilled labor—Continued.					
Carpenter, \$1,393.28.....				1	Chairman's letter Feb. 15, 1913. 12-hour day on concrete.
Carpenter, \$796.16.....				4	Chairman's letter Feb. 15, 1913. 12-hour day on concrete.
Conductor-foreman, \$2,520.....				5	Chairman's letter Jan. 29, 1913. For coal run; supply train; track shifters (2); first division chief engineer's office.
Conductor (qualified), \$2,280.....			10	25	Chairman's letter Mar. 7, 1913. Account 12-hour day on excavation and concrete work.
Conductor (unqualified), \$1,800.....			54	61	Chairman's letter Nov. 14, 1912. To man equipment* transferred to this division and keep same in service on 12-hour day.
Do.....			54	65	Chairman's letter Jan. 3, 1913. To man additional equipment transferred to this division from other divisions.
Craneman, steamshovel, \$2,220.....			26	27	Chairman's letter Nov. 1, 1912. To complete crew for additional shovel put in operation.
Do.....			26	32	Chairman's letter Dec. 4, 1912. To keep all shovels going full capacity 12 hours per day.
Do.....			26	33	Chairman's letter Feb. 25, 1913. As extra to avoid shutting down shovel on account of sickness or other absence.
Engineer, locomotive (qualified), \$2,520.....			10	25	Chairman's letter Mar. 7, 1913. Account 12-hour day on excavation and concrete work.
Engineer, locomotive (unqualified), \$2,160.....			55	62	Chairman's letter Nov. 14, 1912. To man equipment transferred to this division and keep same in service 12 hours a day.
Do.....			55	66	Chairman's letter Jan. 3, 1913. To man additional equipment transferred from other divisions.
Do.....			55	71	Chairman's letter Jan. 29, 1913. Coal run; supply train; track shifters (2); First division, chief engineer, office work.
Engineer, narrow gauge, \$1,800.....			6	9	Chairman's letter Mar. 28, 1913. For approximately 3 months for filling Miraflores lower guide wall, and 12-hour day on concrete.
Engineer, steam (road roller), \$1,620.....			18	21	Chairman's letter Mar. 28, 1913. New townsite and administration building.
Engineer, steam shovel, \$2,520.....			28	29	Chairman's letter Oct. 30, 1912. To fill vacancy caused by resignation of O. M. Robinson with 63 days leave to his credit.
Do.....			28	33	Chairman's letter Dec. 4, 1912. To keep all shovels going full capacity 12 hours per day.
Do.....			28	34	Chairman's letter Feb. 25, 1913. As extra to avoid shutting down shovel on account of sickness and other absences.

## DEPARTMENT OF CONSTRUCTION AND ENGINEERING—Continued.

Designation.	Increase in pay.		Increase in number.		Explanation.
	Rate authorized in organization of July 1, 1910.	Increased to—	Number authorized in 1913 Book of Estimates.	In-creased to—	
OFFICE OF CHIEF ENGINEER—Continued.					
FIFTH DIVISION—contd.					
Wireman, \$1,950.....			4	5	Chairman's letter July 16, 1912. Increased from \$150 on account of increased duties in consequence of abolishment of Balboa substation operator at \$137.50 per month.
SIXTH DIVISION.					
Carpenter, \$1,680.....				2	(*)
Clerk (chief), \$2,400.....				1	(*)
Clerk, \$2,100.....				1	(*)
Draftsman.....	\$1,800.00	2,100.00	1	2	1 transferred from dry dock; 1 in place of \$1,800 account reorganization; chairman's letter May 15.
Draftsman, \$900.....				1	Temporarily transferred from Dry Dock GO-3471.
Engineer (resident).....	\$6,000.00	7,500.00	1	1	(*)
Engineer (junior), \$2,400.....				1	(*)
Engineer, \$2,400.....			2	3	Account dredge Corozal.
Engineer, \$2,280.....				1	Account dredge Corozal.
Engineer, \$2,100.....			9	10	Account transfer dredge No. 85 from Atlantic division; chairman's letter July 27, 1912.
Engineer, \$1,860.....			35	38	2 account chairman's letters Sept. 14, 1912, account tug Reliance put on 24-hour shift; 1 in lieu of higher rate.
Engineer, \$1,620.....			5	7	1 in lieu of higher rate; 1 account transfer dredge No. 85 from Atlantic division; chairman's letter July 27, 1912.
Engineer, \$1,500.....			4	6	1 account transfer dredge No. 85 from Atlantic division; chairman's letter July 27, 1912; 1 account reorganization; chairman's letter May 15.
Engineer, \$1,200.....			2	3	(*)
Foreman.....	2,400.00	2,700.00	2	3	(*)
Foreman, \$2,100.....			6	7	Temporary account rebuilding dredge No. 85; chairman's letter Aug. 8, 1912.
Foreman, \$1,800.....			4	6	1 account pipeline dredge No. 85 chairman's letter Sept. 13, 1912.
Foreman, \$1,500.....			8	9	(*)
Foreman, \$900.....				1	In lieu of higher rate.
Master, \$2,520.....			4	5	Omitted from estimate through error.
Master, \$2,400.....			3	5	1 account transfer dredge No. 85 from Atlantic division; chairman's letter July 27, 1912; 1 for dredge Corozal.
Master, \$2,280.....				1	For dredge Corozal.
Master, \$2,040.....			10	12	(*)
Master, \$1,980.....			11	15	1 in place of mate account tug Reliance on 24-hour shift; chairman's letter Sept. 14, 1912; 2 dredge Corozal.
Master, \$1,800.....			1	4	In lieu of higher rate.
Mate, \$2,100.....			6	7	Account transfer dredge No. 85 from Atlantic division; chairman's letter, July 27, 1912.
Mate, \$1,920.....			2	3	(*)
Mate, \$1,620.....			4	8	Account transfer dredge No. 85 from Atlantic division; chairman's letter, July 27, 1912; 2 transferred from Gatun in lieu of higher rate.

NOTE.—All items (\*) account reorganization; authority chairman's letter May 15, 1913.

## DEPARTMENT OF CONSTRUCTION AND ENGINEERING—Continued.

Designation.	Increase in pay.		Increase in number.		Explanation.
	Rate authorized in organization of July 1, 1910.	Increased to—	Number authorized in 1913 Book of Estimates.	In-creased to—	
OFFICE OF CHIEF ENGINEER—Continued.					
SIXTH DIVISION—continued.					
Mate, \$1,500.....				1	Account transfer dredge No. 85 from Atlantic division; chairman's letter, July 27, 1912.
Mate, \$1,200.....			2	4	In lieu of higher rate.
Machinist, \$1,680.....				2	(*)
Oiler, \$1,200.....				2	Sand cranes.
Operator, \$1,620.....			2	10	2 account dredge No. 85 (July 27, 1912); 3 account chairman's letter, Oct. 13, 1912; 2 transferred from Gatun; 1 in lieu of higher rate.
Operator, \$1,500.....			1	2	In lieu of higher rate.
Rodman.....			5	10	3 for survey Gatun Lake; 2 account reorganization (May 15, 1913).
Scaler (boiler), \$1,200.....			1	3	(*)
Steward, \$1,200.....				1	In lieu of higher rate.
ATLANTIC DIVISION.					
Dock 13: Coxswain, \$1,200.....				1	By transfer from harbor and channel.
Colon breakwater:					
Engineer, steam, \$900.....				1	Operation of barge No. 12, removing material from trestle.
Foreman (barge), \$1,320.....				1	By transfer from harbor and channel.
Dry dock: Rigger, \$1,244.....				1	Increased duties and responsibilities due to abolishing 1 foreman rated at \$1,980.
Porto Bello:					
Engineer, steam, \$1,800.....			6	9	1 by transfer from Gatun Dam, 2 by transfer from Colon breakwater.
Engineer, steam, \$1,500.....			1	3	Decrease in number at higher rating.
Engineer, steam, \$1,500.....		\$1,650.00			Increase in pay on account of more than 1 year satisfactory service, Circular 229-J.
Engineer, locomotive, \$2,160.....			7	10	By transfer from Colon breakwater.
Engineer, steam shovel, \$2,520.....			5	6	Extra man for sickness and vacations.
Foreman, general, \$2,400.....				1	In lieu of superintendent at \$3,600.
Foreman, general, \$2,100.....		2,400.00			Increased duties and responsibilities due to additional equipment assigned to Porto Bello.
Foreman, \$1,800.....			3	4	1 omitted from estimates.
Conductor, \$1,800.....				1	Operation of Lidgerwood plow, and substitution of 6 trainmen at \$420 for 6 at \$1,200.
Hostler, \$1,680.....				1	By transfer from Colon Breakwater.
Trainman, \$1,200.....			7	8	Extra man for sickness and vacations.
Yardmaster, \$2,100.....				1	In lieu of 1 general foreman at \$2,100.
Car repairer, \$1,393.28.....				1	Increase of equipment assigned to Porto Bello.
Blacksmith, \$1,617.20.....			1	2	Decrease of 1 blacksmith at \$1,741.60.
Craneman, steamshovel, \$2,220.....			5	6	Extra man for sickness and vacations.
Locks: Transitman, \$1,800.....			2	3	By transfer from dam and spillway, and in lieu of 1 foreman at \$1,800.

NOTE.—All items (\*) reorganization authority; chairman's letter May 15, 1913.

## DEPARTMENT OF CONSTRUCTION AND ENGINEERING—Continued.

Designation.	Increase in pay.		Increase in number.		Explanation.
	Rate authorized in organization of July 1, 1910.	Increased to—	Number authorized in 1913 Book of Estimates.	In-creased to—	
OFFICE OF CHIEF ENGINEER—Continued.					
ATLANTIC DIVISION—contd.					
Power plant:					
Station recorder, \$1,650.....		\$1,800.00			Increased duties and responsibilities due to abolishing 1 operator, switchboard, at \$1,500.
Operator, pump, \$1,620.....			7	8	Extra man for sickness, vacations, and days off for Sunday work.
Dam and spillway: Engineer, junior, \$2,100.....				1	By 1 foreman, general, transferred from locks, and designation changed.
Municipal engineering:					
Foreman, general, \$2,400.....			1	2	Construction of new Colon waterworks.
Foreman, \$1,800.....			7	9	1 in lieu of 2 carpenters at \$1,617.20; 1 on account of construction of new Colon waterworks.
Engineer, steam, \$1,500.....			2	3	Construction of new Colon waterworks.
Carpenter, \$1,617.20.....				4	Do.
Transportation: Yardmaster, \$2,520.....			2	4	1 in lieu of 1 conductor foreman at \$2,520; 1 to handle train movements at Quebrancha quarry, securing armor rock for dam.
CENTRAL DIVISION.					
Conductor, qualified, \$2,280.....			125	165	Letter attached.
Conductor, foreman, \$2,520.....				1	Letter attached.
Conductor, \$2,280.....					
Yardmaster, \$2,520.....				3	Letter attached.
Conductor, \$2,280.....					
Craneman, steam shovel, \$2,220.....			45	54	Letter attached.
Dispatcher, assistant chief, \$1,800.....				1	Letter attached.
Engineer, assistant, \$2,700.....				1	Letter attached.
Engineer, junior, \$2,100.....			2	3	Letter attached.
Engineer, locomotive, \$2,520.....			125	172	Letter attached.
Engineer, steam, \$1,650.....			6	12	Explained Oct. 12, 1912; item No. 27.
Engineer, steam shovel, \$2,520.....			45	51	Letter attached.
Foreman, \$1,920.....				1	Explained Oct. 12, 1912; No. 37.
Foreman, \$2,700.....			4	5	Letter attached.
Towerman, \$900.....				9	Explained Oct. 12, 1912; No. 60.
Transitman, \$1,800.....			6	8	Explained Oct. 12, 1912; No. 60.
Wireman, blasting, \$1,500.....			7	8	Letter attached.
Yardmaster, \$2,280.....			4	5	Explained Oct. 12, 1912; No. 64.
Yardmaster, \$2,520.....			2	6	Letter attached.
Yardmaster, assistant, \$1,200.....				1	Letter attached.

ISTHMIAN CANAL COMMISSION,  
Empire, Canal Zone, July 29, 1913.

[Subject: Explanation in increase in salaries and positions, Central Division, Annual Report, 1913.]

Col. GEO. W. GOETHALS,  
Chairman and Chief Engineer,  
Culebra, Canal Zone.

SIR: In compliance with instructions contained in your circular letter of July 24, 1913, calling for comparative statements of the Central division organization as of July 1, 1910, and as stipulated in the 1913 book of estimates, together with explanation of increases in pay and in number authorized, statement requested is inclosed herewith, and the following explanations are submitted relative to increases in force over the figures quoted in the 1913 estimate book, a few of which were explained in letter from this office of October 12, 1912, when slightly different conditions obtained on the work in this division.

Foreman conductor, yardmaster } Double ratings.  
Conductor, conductor }

In the case of these double ratings there is no actual increase in force, as they are paid in accordance with duties rendered; in most instances they are used to relieve men who are in the hospital or on vacation



## DEPARTMENT OF CONSTRUCTION AND ENGINEERING—Continued.

Designation.	Increases in pay		Increases in numbers.		Explanation.
	Rate authorized in organization of July 1, 1910.	Increased to—	Number authorized in 1913 Book of Estimates.	In-creased to—	
OFFICE OF CHIEF ENGINEER—Continued.					
MECHANICAL DIVISION.					
Clerk, \$900.....			3	4	1 transferred from Atlantic division to mechanical division with dry-dock shops on May 1, 1913, and approved in chairman's letter of Apr. 26, 1913.
Clerk, \$1,350.....				1	1 authorized in chairman's letter of Aug. 12, 1912, to handle work from central division transferred to mechanical division with Empire shops and wrecking outfit, July 1, 1912.
Clerk, \$1,800.....			8	11	1 authorized for Mr. H. Rowe, with transfer of Miraflores power plant from fifth division, May 1, 1913, and approved in chairman's letter of Apr. 26, 1913. 2 transferred to mechanical division with dry dock shops from Atlantic division, May 1, 1913, and approved in chairman's letter of May 2, 1913.

according to the exigencies of the service, and in one case it was necessary to create the double rating for a man employed on Cucaracha slide, working at night, when he was both a yardmaster and a conductor. *Steam-shovel cranimen.*—The inauguration of the 12-hour shift in the canal, combined with the customary amount of sickness amongst the crews, as well as vacations, is responsible for the increased number of steam-shovel crews and transportation crews; primarily this increase was due to opening up of work on the upper levels on both sides of the canal.

*Assistant chief dispatcher, \$150 (\$1,800).*—No increase in authorized force; one position as operator abolished and position of assistant chief dispatcher at the same rate was created; change was necessary on account of the duties performed by the incumbent.

*Assistant engineer, \$2,700.*—No increase in regular authorized force; on account of the promotion of one assistant engineer at \$3,300 to the position of superintendent of construction, the vacancy was filled at \$2,700 only, the higher rating being abolished from the organization. Recently the \$2,700 position has also been eliminated from the organization.

*Locomotive engineers, \$2,520.*—Same explanation governs as was given in the case of steam-shovel cranimen.

*Steam-shovel engineers, \$2,520.*—Same explanation governs as was given in the case of steam-shovel cranimen.

*Foremen, general, \$2,700.*—The superintendent of construction of the Chagres district resigned from the service; his position was abolished, and the work placed in charge of a general foreman at \$2,700 per annum. Likewise the position of the assistant superintendent of construction was abolished from the authorized force following his resignation from the service. This arrangement effected considerable economy in the division. The increase in force lasted only a short time on account of the abolition of one of these positions following the resignation of one of the foremen, creating a position as foreman at a lower salary.

*Blasting wiremen, \$1,500.*—This increase was explained under date of October 12, 1912, as being due to excessive sickness and the large number of men on leave of absence; those conditions do not obtain at this time, although the authorized force figures remain the same. The estimated number of six has proven ample for the work, and it has not been exceeded for six months.

*Yardmasters, \$2,520.*—This item shows an increase of four positions over the 1913 Estimate Book. Owing to the exigencies of the service requiring the promotion of conductors to yardmasters, three positions as yardmaster at \$2,520 per annum were abolished to create three similar positions at \$2,520 per annum, thus effecting a slight economy. One position as yardmaster at \$2,520 per annum was created on account of the installation of the 12-hour shift in the canal, which called for the services of another yardmaster to be stationed on the south end on the dumps. This created an actual increase of one yardmaster.

*Assistant yardmaster, \$1,200.*—There is no actual increase in force in this instance, as one position as foreman at \$1,200 per annum was abolished to create this position as assistant yardmaster at the same rate. Change was made in rating on account of the urgent necessity which existed for a yardmaster's assistant on the south end of the cut in connection with the work of the 12-hour shift.

Authority contained in chairman's letter of April 29, 1913.

*Conductors, \$2,250.*—The same explanation obtains as was given in the case of steam-shovel cranimen.

*Junior engineer, \$2,100.*—This increase of one was necessitated on account of the transfer of an experienced assistant engineer to another branch of the work in the canal, the absence of the division engineer, whose duties consequently devolved upon the resident engineer, as acting head of the division, placing additional work and responsibility upon the latter's subordinates, and also the large amount of miscellaneous engineering work required at that time. In lieu of this addition to the force one position as transitman at \$1,800 per annum was abolished.

Authority contained in letter from the chairman and chief engineer, dated May 19, 1913.

By direction of the division engineer.

Very respectfully,

A. S. ZINN, Resident Engineer.

## DEPARTMENT OF CONSTRUCTION AND ENGINEERING—Continued.

Designation.	Increase in pay.		Increase in number.		Explanation.
	Rate authorized in organization of July 1, 1910.	Increased to—	Number authorized in 1913 Book of Estimates.	Increased to—	
OFFICE OF CHIEF ENGINEER—Continued.					
MECHANICAL DIVISION—continued.					
Clerk, \$2,100.....			2	3	1; see letter of Mr. A. L. Robinson, dated Sept. 18, 1912, requesting increase to \$175 for Edd Quinn, property clerk, on account of increased duties, and approved by chairman in his letter of Sept. 20, 1912.
Foreman, \$1,740.....			2	4	2 transferred with Cristobal car shops from Panama R. R. to mechanical division, May 1, 1913, and approved in chairman's letter of Apr. 24, 1913.
Foreman, \$2,280.....				1	2; see last year's report. 1 transferred from Panama R. R. to mechanical division with the Cristobal car shops, May 1, 1913, and approved in chairman's letter of Apr. 24, 1913.
Foreman, \$2,400.....			12	13	1 transferred to mechanical division from fifth division, with the transfer of Miraflores power plant to mechanical division, May 1, 1913, and approved in chairman's letter of May 2, 1913.
Foreman, \$2,700.....			7	9	1 transferred with the Miraflores power plant from fifth division to mechanical division, on May 1, 1913, and approved in chairman's letter of May 2, 1913.
Foreman, \$3,000.....				1	1; see report of last year. Transfer of Mr. J. H. Moriarty from central division to mechanical division, with Empire shops, July 1, 1912.
Foreman.....	\$3,300.00	\$3,600.00		1	Increase of J. J. Eason, in reorganization of mechanical division, as approved in chairman's letter of July 11, 1912.
Inspector, \$1,800.....			1	2	1; see report of last year. 1; see chairman's letter of Mar. 20, 1913, authorizing an inspector for the 4 tanks being erected by the Petroleum Iron Works.
Superintendent, electrical...	3,000.00	3,900.00	1	1	See letter of chairman dated Mar. 26, 1913, increasing this position on account of transfer of Miraflores power plant to mechanical division.
Superintendent, steam shovel repairs, \$3600.				1	Transferred from central to mechanical division, on July 1, 1912, with the Empire shops.
Foreman, \$1,800.....			11	13	1 transferred from Atlantic division to mechanical division, with dry-dock shops, May 1, 1913, and approved by chairman in letter of May 2, 1913. 1 transferred from Panama R. R. with Cristobal car shops on May 1, 1913, and approved in chairman's letter of Apr. 2, 1913.

## DEPARTMENT OF CONSTRUCTION AND ENGINEERING—Continued.

Designation.	Increase in pay.		Increase in number.		Explanation.
	Rate authorized in organization of July 1, 1910.	Increased to—	Number authorized in 1913 Book of Estimates.	Increased to—	
OFFICE OF CHIEF ENGINEER—Continued.					
MECHANICAL DIVISION—con.					
Foreman, \$1,920.....			4	5	1 transferred with dry-dock shops from Atlantic division to mechanical division May 1, 1913, and approved by chairman in letter of May 2, 1913.
Foreman, \$1,950.....			1	3	4; see last year's statement. 2 transferred with dry-dock shops from Atlantic division to mechanical division, May 1, 1913, and approved by chairman in letter of May 2, 1913.
Foreman, \$2,100.....			12	19	3 transferred with dry-dock shops from Atlantic division to mechanical division May 1, 1913, and approved by chairman in letter of May 2, 1913. 1 transferred from fifth division with Miraflores power plant to mechanical division May 1, 1913, and approved by chairman in letter of Apr. 26, 1913. 1 Balboa Wharf Agency from Panama R. R. on Mar. 1, 1913, and approved by chairman in letter of Mar. 3, 1913. 1; see letter of chairman dated Aug. 27, 1913, authorizing increase in boiler shop of 1 foreman from \$165 to \$175 per month, on account of increased duties and responsibility. 1; see chairman's letter dated Jan. 7, 1913, authorizing 1 foreman at \$175 during leave of Robert Bailey to decrease number of cases where hourly men are appointed to take monthly men's places.
Apprentice, \$248.80.....			6	7	Increases due to promotions, in accordance with apprentice scale.
Apprentice, \$497.60.....			1	2	
Apprentice, \$622.....				1	2 transferred to mechanical division from Atlantic division with transfer of dry-dock shops May 1, 1913, and covered by approval of chairman in his letter of May 2, 1913. 1 transferred to mechanical division from Panama R. R. with transfer of Cristobal car shops on May 1, 1913, and approved by chairman in his letter of Apr. 24, 1913. 1 transferred from central division to mechanical division July 1, 1912, with the Empire shops.
Blacksmith, \$1,094.72.....			14	18	
Blacksmith, \$1,393.28.....			4	6	2; see report of last year.
Blacksmith, \$1,617.20.....			30	46	6 approved in chairman's letter of Aug. 26, 1912, on account of increased work for other divisions and holding of reserve men to loan to other divisions.

## DEPARTMENT OF CONSTRUCTION AND ENGINEERING—Continued.

Designation.	Increase in pay.		Increase in number.		Explanation.
	Rate authorized in organization of July 1, 1910.	Increased to—	Number authorized in 1913 Book of Estimates.	In-creased to—	
OFFICE OF CHIEF ENGINEER—Continued.					
MECHANICAL DIVISION—con.					
Blacksmith, \$1,617.20 (continued).			30	46	6 as requested in Mr. A. L. Robinson's letter of Nov. 2, 1912, account of large amount of work being performed at that time for other divisions, and approved by chairman in his letter of Nov. 6, 1912.
					2 transferred from Atlantic division to mechanical division with dry-dock shops on May 1, 1913, and approved in chairman's letter dated May 2, 1913.
Blacksmith, \$1,741.60.....			1	3	2; see report of last year. 1 transferred from Atlantic division to mechanical division with dry-dock shops on May 1, 1913, and approved in chairman's letter of May 2, 1913.
					1 transferred from central division with Empire shops, July 1, 1912.
Boilermaker, \$796.16.....				1	1; see report of last year relative to Ed. Good 1 transferred from Atlantic division to mechanical division with the dry-dock shops on May 1, 1913, and approved in chairman's letter of May 2, 1913.
Boilermaker, \$945.44.....			11	12	1 transferred from central division to mechanical division with Empire shops on July 1, 1912.
Boilermaker, \$1,094.72.....			32	40	1 transferred from Atlantic division to mechanical division with dry-dock shops on May 1, 1913, and approved in chairman's letter May 2, 1913.
					7; see letter of A. L. Robinson, dated Sept. 6, 1912, requesting increase on account of great amount of work in boiler shop, and approved in chairman's letter of same date.
Boilermaker, \$1,393.28.....			10	26	1 transferred from Atlantic division to mechanical division with dry-dock shops, May 1, 1913, and approved in chairman's letter of May 2, 1913.
					10 account of great amount of work in boiler shop, requested in A. L. Robinson's letter of Sept. 6, 1913, and approved in chairman's letter of same date.
Boilermaker, \$1,617.20.....			51	67	5; see report of last year. 5 on account of large amount of work in boiler shop and furnishing reserve men to other divisions, as requested in Mr. Robinson's letter of Sept. 6, 1912, and approved in chairman's letter of same date.
					3 transferred from Atlantic division to mechanical division with the dry-dock shops on May 1, 1913, and approved in chairman's letter dated May 2, 1913.
					8; see report of last year.

## DEPARTMENT OF CONSTRUCTION AND ENGINEERING—Continued.

Designation.	Increase in pay.		Increase in number.		Explanation.
	Rate authorized in organization of July 1, 1910.	Increased to—	Number authorized in 1913 Book of Estimates.	Increased to—	
OFFICE OF CHIEF ENGINEER—Continued.					
MECHANICAL DIVISION—con.					
Boilermaker, \$2,100.....				4	Transferred to mechanical division from central division with Empire shops on July 1, 1913.
Car inspector and repairer, \$1,800.....				5	2 authorized in chairman's letter of Dec. 14, 1912, on account of handling car inspection in Balboa yards for Panama R. R. 3 transferred from Panama R. R. to mechanical division on May 1, 1913, with Cristobal car shops, and approved in chairman's letter of Apr. 24, 1913.
Car repairer, \$1,617.20.....			7	10	3 transferred from Panama R. R. with Cristobal car shops on May 1, 1913, and approved in chairman's letter of Apr. 24, 1913.
Carpenter, \$1,393.28.....			7	11	7; see report of last year. 2 transferred from Atlantic division to mechanical division with dry-dock shops on May 1, 1913, and approved by chairman in his letter of May 2, 1913.
Carpenter, \$1,617.20.....			2	6	2; see report of last year. 2 transferred with dry-dock shops from Atlantic division to mechanical division, May 1, 1913, and approved in chairman's letter of May 2, 1913.
Checker, \$1,200.....			6	7	1 authorized in chairman's letter of Aug. 26, 1913, on account of large amount of work being done for other divisions. 1 transferred with Empire shops from central division to mechanical division, July 1, 1912.
Checker, \$1,500.....			1	5	1 account of man to handle injury claims, as requested in Mr. Robinson's letter of Apr. 10, 1913, and approved in chairman's letter of Apr. 12, 1913. 1 transferred from central division to mechanical division July 1, 1913, with transfer of Empire shops. 1 authorized in chairman's letter of July 27, 1912, to take the place of a clerk at Pedro Miguel engine house at same rate of pay. 1 requested in A. L. Robinson's letter of Oct. 31, 1912, to take place of clerk in general foreman's office at Gorgona on account of promotions from there, handicapping work in both offices, and approved in chairman's letter of Nov. 2, 1912. 1 authorized to handle work in Asst. Gen. Foreman Herman's office at Empire, where car work was taken from Panama R. R. on May 1, 1913, and approved by chairman Apr. 24, 1913.

## DEPARTMENT OF CONSTRUCTION AND ENGINEERING—Continued.

Designation.	Increase in pay.		Increase in number.		Explanation.
	Rate authorized in organization of July 1, 1910.	Increased to—	Number authorized in 1913 Book of Estimates.	In-creased to—	
OFFICE OF CHIEF ENGINEER—Continued.					
MECHANICAL DIVISION—con.					
Coach cabinetmaker, \$1,617.20.			6	18	2 authorized in chairman's letter of Aug. 26, 1913, on account of extra carwork and night and day shifts.
					10 requested in A. L. Robinson's letter of Oct. 14, 1912, on account of construction of sight-seeing car, conversion of second-class coach into parlor car, and large amount of coach work to be handled previous to tourist season, approved by chairman in letter of Oct. 18, 1912.
Conductor, foreman, \$2,520.			1	2	1 transferred from central division with wrecking outfit July 1, 1912.
					1 to handle yard at Gorgona shops, as set forth in acting chairman's letter of Jan. 30, 1912, replacing qualified conductor.
Coppersmith, \$1,094.72.			1	2	1 transferred from Atlantic division with dry-dock shops May 1, 1913, and approved in chairman's letter of May 2, 1913.
Coppersmith, \$1,617.20.			5	11	1 transferred from Atlantic division with dry-dock shops to mechanical division on May 1, 1913, and approved by chairman in letter of May 2, 1913.
					3 changed from tinsmith, at same rate, as approved in chairman's letter dated Aug. 26, 1912.
					2 requested in A. L. Robinson's letter of Oct. 21, 1912, and approved by chairman in letter of Oct. 23, 1912, on account of large amount of work being handled by the mechanical division for other divisions.
Crane operator, \$1,200.				7	7 transferred from Panama R. R. Balboa agency on Mar. 1, 1913, and approved in chairman's letter of Mar. 3, 1913.
Engineer, steam, \$1,500.			6	9	2 transferred from Atlantic division to mechanical division with dry-dock shops on May 1, 1913, and approved by chairman in letter of May 2, 1913.
					1 transferred from fifth division on May 1, 1913, as approved in chairman's letter of Apr. 26, 1913.
Engineer, steam, \$1,650.				1	1 transferred from fifth division with the Miraflores power plant on May 1, 1913, and approved in chairman's letter of Apr. 26, 1913.
Engineer, steam, \$1,800.			5	6	1 transferred from central division on July 1, 1912, with Empire shops.
Engineer, steam, \$2,400.				1	1 transferred from fifth division to mechanical division on May 1, 1913, and approved in chairman's letter of Apr. 26, 1913.
Engineer, qualified, \$2,520.			1	2	1 account of transfer of wrecker from central division to mechanical division, July 1, 1913.

## DEPARTMENT OF CONSTRUCTION AND ENGINEERING—Continued.

Designation.	Increase in pay.		Increase in number.		Explanation.
	Rate authorized in organization of July 1, 1910.	Increased to—	Number authorized in 1913 Book of Estimates.	Increased to—	
OFFICE OF CHIEF ENGINEER—Continued.					
MECHANICAL DIVISION—con.					
Engineer, station, \$2,400.....				1	Transferred from the fifth division with Miraflores power plant on May 1, 1913, and approved in chairman's letter of Apr. 26, 1913.
Fireman, \$1,500.....			1	2	1 transferred from fifth division to mechanical division with Miraflores power plant on May 1, 1913, and approved by chairman in letter of Apr. 26, 1913.
Ironworker, \$1,098.24.....				3	3 transferred with the dry-dock shops from the Atlantic division to the mechanical division on May 1, 1913, approved in chairman's letter of May 2, 1913.
Ironworker, \$1,622.40.....				4	4 transferred with the dry-dock shops from the Atlantic division to the mechanical division on May 1, 1913, approved in chairman's letter of May 2, 1913.
Ironworker, special, \$1,747.20.....				1	1 transferred with the dry-dock shops from the Atlantic division to the mechanical division on May 1, 1913, approved on May 2, 1913, chairman's letter of that date.
Lineman, \$1,500.....				1	1 transferred to mechanical division from central division with Empire shops on July 1, 1912.
Lineman, \$1,800.....			2	4	2 transferred to mechanical division from the fifth division with Miraflores power plant on May 1, 1913, and approved in chairman's letter of Apr. 26, 1913.
Machinist, \$796.16.....			6	11	4 requested in Mr. A. L. Robinson's letter, dated Oct. 25, 1912, on account of great amount of work in shop from other divisions, and approved by chairman in his letter of Oct. 28, 1912.
Machinist, \$945.44.....			14	25	1 transferred from central division with Empire shops on July 1, 1912.
					6 requested by Mr. A. L. Robinson in letter dated Oct. 25, 1912, on account of great amount of work in shop from other divisions, and approved in chairman's letter of Oct. 28, 1912.
Machinist, \$1,094.72.....			30	31	5 transferred with Empire shops from central division to mechanical division, July 1, 1912.
					1 transferred with the dry-dock shops from the Atlantic division to mechanical division on May 1, 1913, and approved in chairman's letter of May 2, 1913.
Machinist, \$1,393.28.....			18	26	1 transferred with dry-dock shops on May 1, 1913, from Atlantic division to mechanical division, and approved on May 2, 1913, in chairman's letter of that date.
					7 transferred to mechanical division from central division with Empire shops on July 1, 1912.

## DEPARTMENT OF CONSTRUCTION AND ENGINEERING—Continued.

Designation.	Increase in pay.		Increase in number.		Explanation.
	Rate authorized in organization of July 1, 1910.	Increased to—	Number authorized in 1913 Book of Estimates.	Increased to—	
OFFICE OF CHIEF ENGINEER—Continued.					
MECHANICAL DIVISION—CON.					
Machinist, \$1,617.20.....			274	352	21 transferred from Atlantic division to mechanical division with dry-dock shops on May 1, 1913, and approved in chairman's letter of May 2, 1913. 15 requested in Mr. A. L. Robinson's letter of Sept. 26, 1912, on account of men on vacation leave, sick and injury leave, and loaning men to other divisions, and approved in chairman's letter of Sept. 28, 1912. 15 increases requested in Mr. A. L. Robinson's letter of Oct. 21, 1912, on account of great amount of work in shop from other divisions, and approved in chairman's report of Oct. 23, 1912. 27 transferred to mechanical division from central division with Empire shops, July 1, 1912.
Machinist, \$1,741.60.....				1	1 transferred from Atlantic division to mechanical division on May 1, 1913, and approved in chairman's letter of May 2, 1913.
Machinist, \$2,100.....				8	These positions transferred from central division to mechanical division with Empire shops, July 1, 1912.
Machinist, electrical, \$1,650.....				1	Transferred from fifth division to mechanical division with Miraflores power plant on May 1, 1913, and approved in chairman's letter of Apr. 26, 1913.
Machinist, electrical, \$1,800.....				1	Transferred from fifth division to mechanical division with Miraflores power plant on May 1, 1913, approved in chairman's letter of Apr. 26, 1913.
Molder, \$1,393.78.....				2	Requested in Mr. A. L. Robinson's letter of July 27, 1912, and approved in chairman's letter of Aug. 26, 1912.
Oxy-Acet., welder, \$1,393.28.....				1	Requested in Mr. A. L. Robinson's letter of Feb. 18, 1913, to make place for a man who was employed in United States on Feb. 3, to handle this kind of work, and approved in chairman's letter dated Feb. 20, 1913.
Operator, switchboard, assistant, \$1,500.....				2	Transferred with Miraflores power plant from fifth division to mechanical division, May 1, 1913, and approved in chairman's letter of Apr. 26, 1913.
Operator, switchboard, assistant, \$1,800.....				3	Transferred with Miraflores power plant from fifth division to mechanical division, May 1, 1913, and approved in chairman's letter of Apr. 26, 1913.



## DEPARTMENT OF CONSTRUCTION AND ENGINEERING—Continued.

Designation.	Increase in pay.		Increase in number.		Explanation.
	Rate authorized in organization of July 1, 1910.	Increased to—	Number authorized in 1913 Book of Estimates.	Increased to—	
OFFICE OF CHIEF ENGINEER—Continued.					
MECHANICAL DIVISION—con.					
Operator, switchboard, chief, \$2,100.				1	Transferred with Miraflores power plant from the fifth division to mechanical division, May 1, 1913, and approved in chairman's letter of Apr. 26, 1913.
Operator, substation, \$1,650.				1	Transferred with Miraflores power plant from fifth division to mechanical division on May 1, 1913, and approved in chairman's letter of Apr. 26, 1913.
Operator, electric pump, \$1,620.				3	Transferred with Miraflores power plant from fifth division to mechanical division on May 1, 1913, and approved in chairman's letter of Apr. 26, 1913.
Painter, \$1,617.20.				6	2 requested in Mr. A. L. Robinson's letter of Oct. 14, 1912, on account of constructing sight-seeing car, converting second-class coach into observation car, and owing to great amount of coach work to be done before tourist season, and approved by chairman in letter of Oct. 18, 1912. Balance, see last report.
Pipe fitter, \$1,393.28.				6	Requested in Mr. A. L. Robinson's letter of July 27, 1912, and approved in chairman's letter of Aug. 26, 1912.
Pipe fitter, \$1,617.20.			11	21	1 transferred with dry-docks shops from Atlantic division to mechanical division on May 1, 1913, and approved in chairman's letter of May 2, 1913. 6 requested in Mr. A. L. Robinson's letter of July 27, 1912, and approved in chairman's letter of Aug. 26, 1912.
					1 rerating of man previously carried as steam fitter, as approved in chairman's letter of Nov. 19, 1912.
					2 requested in Mr. A. L. Robinson's letter of Nov. 13, 1912, on account of great amount of work on hand from other divisions, and approved by chairman in letter of Nov. 15, 1912.
Pipe fitter, \$1,741.60.			1	3	1 transferred from Atlantic division with dry-dock shops on May 1, 1913, and approved in chairman's letter of May 2, 1913.
					1 transferred with Empire shops from central division, July 1, 1912.
Pipe fitter, \$2,100.				1	See last report covering 1 transferred from central division with Empire shops, on July 1, 1912.
Recorder, station, \$1,650.				1	Transferred with Miraflores power plant, from fifth division to mechanical division, on May 1, 1913, and approved in chairman's letter of May 2, 1913.

## DEPARTMENT OF CONSTRUCTION AND ENGINEERING—Continued.

Designation.	Increase in pay.		Increase in number.		Explanation.
	Rate authorized in organization of July 1, 1910.	Increased to—	Number authorized in 1913 Book of Estimates.	In-creased to—	
OFFICE OF CHIEF ENGINEER—Continued.					
MECHANICAL DIVISION—CON.					
Shipwright, \$796.16.....				5	Transferred with dry-dock shops from Atlantic to mechanical division, May 1, 1913, and approved in chairman's letter of May 2, 1913.
Ship fitter, \$1,617.20.....				3	Transferred with dry-dock shops from Atlantic division to mechanical division, May 1, 1913, and approved in chairman's letter of May 2, 1913.
Ship joiner, \$1,617.20.....				2	Transferred with dry-dock shops from Atlantic division to mechanical division, May 1, 1913, and approved in chairman's letter of May 2, 1913.
Wireman, \$1,617.20.....			18	25	1 transferred with dry-dock shops from Atlantic division to mechanical division, May 1, 1913, and approved in chairman's letter of May 2, 1913. 5 transferred to mechanical division to handle installation of lights and wiring in New Washington Hotel, and approved in chairman's letter of Jan. 8, 1913.
Wireman, \$1,650.....				2	1 requested in Mr. A. L. Robinson's letter of Nov. 14, 1912, to make vacancy for Mr. L. S. Kirby, transferred to mechanical division from Atlantic division, approved in chairman's letter of Nov. 16, 1912.
Wireman, \$1,800.....				3	1 transferred with Miraflores power plant from the fifth division to mechanical division, May 1, 1913, and approved in chairman's letter of May 2, 1913.
Wireman, \$1,950.....				6	Transferred with Miraflores power plant from fifth division to mechanical division, May 1, 1913, and approved by chairman in letter of May 2, 1913.

## DEPARTMENT OF CIVIL ADMINISTRATION.

Division of revenues:					
Deputy collector.....	\$1,800.00	\$2,100.00	-----	1	Effective Dec. 26, 1912, salary of deputy collector in charge of Empire-Gorgona administrative district, after consolidation under Executive order of President of Sept. 21, 1912, effective Sept. 22, 1912, increased from \$1,800 to \$2,100; 1 deputy collector at \$1,800 (Gorgona) being abolished Sept. 22, 1912.

## DEPARTMENT OF CIVIL ADMINISTRATION—Continued.

Designation.	Increase in pay.		Increase in number.		Explanation.
	Rate authorized in organization of July 1, 1910.	Increased to—	Number authorized in 1913 Book of Estimates.	Increased to—	
Division of posts: Postmaster, \$2,000.....			1	2	Effective July 1, 1912, pay of postmaster (Corgona) increased from \$1,900 to \$2,000, account increased postal receipts.
Postal clerk, \$1,200.....				1	See 1912 annual report. After the temporary appointment covered in that report expired there were 4 others of 1, 3, 15, and 6 days, respectively, account resignation of clerks with leave due, but no 2 temporary increases overlapped.
Clerk, \$900.....			2	6	For explanation of 2, see 1912 annual report. The 2 others were temporary appointments; 1, from Feb. 10, 1913, to Mar. 20, 1913, account appointment to vacancy, while former employee was still drawing pay; the other, from Feb. 20, 1913, to May 15, 1913, account appointment to position of clerk, resigning with 84 days' leave.
Division of police: Sergeant, \$1,710.....			4	5	Temporary increase of 1 for 60 days from Mar. 1, 1913, account resignation of deputy warden with 60 days leave.
First-class policeman, \$1,290.....			40	45	Increase of 5 effective Aug. 31, 1912. In reorganization account reduction in appropriation these 5 added, and 1 lieutenant, \$1,920, 5 corporals, \$1,470, and 26 policemen, at \$480, abolished.
Clerk, \$1,500.....			2	3	Temporary, increase of 1 for 6 weeks from Sept. 27, 1912, account appointment of clerk to succeed 1 resigning with 42 days' leave due.
Treasurer's office): Clerk, \$900.....				3	One appointed, effective Oct. 3, 1912, in reorganization account reduction in appropriation when 1 clerk at \$600 was abolished, and later, on Dec. 26, 1912, clerk at \$2,100 abolished. The 2 others were temporary appointments: One from Feb. 4, 1913, to Apr. 28, 1913, account appointment of clerk to succeed 1 who resigned with 84 days' leave due; the other, from Mar. 12, 1913, to Apr. 21, 1913, account shortage in force pending appointment of assistant treasurer.
(Canal Zone government, paid from Zone funds, division of schools): Teacher, high school, \$1,125.....				1	Effective Oct. 3, 1912, to increase pay of teacher acting as principal of consolidated high and grammar school at Gatun.

## DEPARTMENT OF CIVIL ADMINISTRATION—Continued.

Designation.	Increase in pay.		Increase in number.		Explanation.
	Rate authorized in organization of July 1, 1910.	Increased to—	Number authorized in 1913 Book of Estimates.	In-creased to—	
(Canal Zone government, paid from Zone funds, division of schools)—Contd. Teacher, high school, \$990.			1	3	Actual increase of only 1, effective Dec. 13, 1912, to provide increase in pay of teacher at \$810 who taught at Ancon main and Empire branch high schools, account increased duties and travel time.
Teacher, \$810.....			30	33	For other increase, see 1912 annual report, where it was shown by error under principals, grammar school, at \$990. For 2 of these increases, see 1912 annual report.
Teacher (Spanish) \$270..				1	1 appointed, effective Sept. 28, 1912, account establishment of school for white children at Toro Point.
					Approved Aug. 13, 1912, at \$30 per month (9 months, school term) to provide instruction in Spanish at the high schools which under the contemplated organization of force and plan of instruction would not have been furnished the pupils during the year.

## DEPARTMENT OF SANITATION.

CHIEF SANITARY OFFICE.					
Chaplain, \$480.....			1	3	There were employed up to July 1, 1913, 3 chaplains, at \$480. Authority in Book of Estimates for 1913 cut this down to 1. On account of vacation time due, it was necessary to authorize 2 additional chaplains at \$480 for a period of 2 months. They are not now employed.
HOSPITAL FARM, COROZAL.					
Superintendent, \$2,400.....				1	On account of establishing a farm at Corozal, an adjunct to Ancon Hospital, where injured employees are to be cared for, it was necessary to increase the organization by authorizing a superintendent at \$2,400 and a clerk at \$1,500 for this farm. The clerk is not now employed and will not be needed until there is a considerable number of patients at the farm.
Clerk, \$1,500.....				1	
ANCON HOSPITAL.					
Nurse, male, \$1,260.....			8	10	On account of the substitution of male for female nurses in the venereal wards at Ancon Hospital, the authorization for female nurses was reduced by 2, and 2 additional male nurses allowed.
PALO SECO LEPER ASYLUM.					
Matron \$900.....				1	On account of the increase in number of patients at this institution, particularly female patients, a matron was authorized at \$75 per month.....

## QUARTERMASTER'S DEPARTMENT.

Designation.	Increase in pay.		Increase in number.		Explanation.
	Rate authorized in organization of July 1, 1910.	Increased to—	Number authorized in 1913 Book of Estimates.	Increased to—	
Officers and employees:					
District quartermaster..	\$2,100.00	\$2,400.00	.....	.....	Increased work in Corozal district.
Assistant district quartermaster.	1,500.00	1,650.00	.....	.....	Increased work in Pedro Miguel district.
Assistant district quartermaster, \$1,500.	.....	.....	3	4	Increased work in Corozal district.
Inspector, \$3,000.	.....	.....	.....	1	In lieu of constructing quartermaster, at \$4,000.
Inspector, \$1,800.	.....	.....	.....	3	One in lieu of clerk, \$175, salary reduced and rating changed to conform with present duties; one for building operations in connection with moving town of Gorgona; and one for inspecting scrap being collected by contractor.
Clerk, \$1,800.	.....	.....	10	12	Increase in lieu of 8 clerks, at \$1,500.
Clerk, \$1,650.	.....	.....	17	19	
Foreman.	2,100.00	2,400.00	.....	.....	Increased work in printing plant
Foreman, \$2,400.	.....	.....	.....	1	In lieu of inspector, at \$2,400.
Foreman, \$1,980.	.....	.....	6	7	Increase of work, account moving town of Gorgona (temporary).
Foreman, \$1,200.	.....	.....	9	10	In lieu of foremen, at \$1,350.
Watchman, \$900.	.....	.....	3	4	Account changes in Balboa storehouse, material more scattered.
Skilled and unskilled labor:					
Plumber, \$1,872.	.....	.....	8	19	Account increased work, moving town of Gorgona (temporary).

## DEPARTMENT OF DISBURSEMENTS.

Chief clerk, \$3,000.	.....	.....	.....	1	On May 1, 1913, due to reorganization of the office, a chief clerk, at \$3,000, was appointed in place of accountant, at \$2,400, due to increased duties and responsibilities.
Clerk.	\$2,100.00	\$2,400.00	.....	5	On May 1, 1913, the work of the office was reorganized, and 5 pay clerks, at \$2,100, were promoted to \$2,400, account of increased duties and heavy responsibility.

## DEPARTMENT OF LAW.

Inspector, \$1,800.	.....	.....	.....	1	\$1,500 in 1913 Book of Estimates; increased to \$1,800 on account of heavy increase in work and duties due to the settlement of claims before joint land commission and clearing Canal Zone of all settlers.
Inspector, \$1,800.	.....	.....	1	2	This second inspector was necessary for reasons above, and while charged to department of law is paid out of the funds for construction and engineering.
Clerk, \$1,500.	.....	.....	3	4	By reason of the increased work in the department, due to joint land commission, a clerk (\$1,500) was temporarily taken on May 6, 1913.

## WASHINGTON OFFICE.

Designation.	Increase in pay.		Increase in number.		Explanation.
	Rate authorized in organization of July 1, 1910.	Increased to—	Number authorized in 1913 Book of Estimates.	Increased to—	
Temporary clerks for all offices.	\$2,000	\$3,533.85	.....	.....	Excess of \$1,533.85, due to increased work throughout the whole office.

The above is in addition to the increases shown in the report for the fiscal year 1912.

## APPENDIX U.

### ACTS OF CONGRESS AFFECTING THE ISTHMIAN CANAL AND EXECUTIVE ORDERS RELATING TO THE CANAL ZONE.

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## APPENDIX U.

### ACTS OF CONGRESS AFFECTING THE ISTHMIAN CANAL AND EXECUTIVE ORDERS RELATING TO THE CANAL ZONE.

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Panama Canal Act, approved August 24, 1912, and Sundry Civil Appropriations Act for the fiscal year ended June 30, 1913, published in Annual Report of the Isthmian Canal Commission for the fiscal year 1912.

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AN ACT Making appropriations for the Diplomatic and Consular Service for the fiscal year ending June thirtieth, nineteen hundred and fourteen.

*Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,* That the following sums be, and they are hereby, severally appropriated, in full compensation for the Diplomatic and Consular Service for the fiscal year ending June thirtieth, nineteen hundred and fourteen, out of any money in the Treasury not otherwise appropriated, for the objects hereinafter expressed, namely:

\* \* \* \* \*

#### RELIEF AND PROTECTION OF AMERICAN SEAMEN.

Relief and protection of American seamen in foreign countries, and shipwrecked American seamen in the Territory of Alaska, in the Hawaiian Islands, Porto Rico, the Panama Canal Zone, and the Philippine Islands, \$20,000.

\* \* \* \* \*

Approved, February 28, 1913.

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AN ACT Making appropriations for the naval service for the fiscal year ending June thirtieth, nineteen hundred and fourteen, and for other purposes.

*Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,* That the following sums be, and they are hereby, appropriated, to be paid out of any money in the Treasury not otherwise appropriated, for the naval service of the Government for the year ending June thirtieth, nineteen hundred and fourteen, and for other purposes:

\* \* \* \* \*

#### PUBLIC WORKS, BUREAU OF YARDS AND DOCKS.

\* \* \* \* \*

Marine barracks, Isthmus of Panama: Erection of barracks, quarters, and other buildings for accommodation of marines, \$400,000.

\* \* \* \* \*

Approved, March 4, 1913.

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AN ACT Making appropriations to supply deficiencies in appropriations for the fiscal year nineteen hundred and thirteen and for prior years, and for other purposes.

*Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,* That the following sums are appropriated, out of any money in the Treasury not otherwise appropriated, to supply deficiencies in appropriations for the fiscal year nineteen hundred and thirteen, and for prior years, and for other purposes, namely:

\* \* \* \* \*

## DEPARTMENT OF STATE.

\* \* \* \* \*

PAYMENT TO PANAMA UNDER TREATY OF NOVEMBER EIGHTEENTH, NINETEEN HUNDRED AND THREE: To enable the Secretary of State to pay to the Government of Panama the first annual payment due on February twenty-sixth, nineteen hundred and thirteen, from the Government of the United States to the Government of Panama under the treaty of November eighteenth, nineteen hundred and three, \$250,000.

\* \* \* \* \*

Approved, March 4, 1913.

---

AN ACT Making appropriations for certain expenses incident to the first session of the Sixty-third Congress, and for other purposes.

*Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the following sums are appropriated, out of any money in the Treasury not otherwise appropriated, namely:*

\* \* \* \* \*

## THE PANAMA CANAL.

SEC. 2. That during the fiscal year nineteen hundred and fourteen, all moneys received by the Isthmian Canal Commission, or the governor of the Panama Canal, from any services rendered or materials and supplies furnished employees, the Panama Railroad Company, the Canal Zone government, the Panama Government, and other departments of the United States Government, from hotel and hospital supplies and services; from rentals, wharfage, and so forth; from labor, materials, and supplies and other services furnished vessels and to those unable to obtain similar labor, materials, supplies, and services elsewhere, shall be credited to the appropriation from which payments for the materials, supplies, labor, or other services were originally made; except that moneys received from the sale of material and equipment purchased and used for construction purposes, and as a reimbursement for the expenditures incurred in constructing waterworks, sewers, and pavements in the cities of Panama and Colon, including interest on such expenditures, excluding payments on account of the expenses for maintenance of such waterworks, sewers, and pavements incurred under agreement with the Panama Government, and otherwise herein disposed of, shall be covered into the Treasury as miscellaneous receipts; and except that after the canal is opened for use and operation the net profits accruing from the operations herein authorized shall annually be covered into the Treasury of the United States, as provided for the profits accruing from the business authorized in section six of the Panama Canal Act.

That until the close of the fiscal year nineteen hundred and fourteen, when any material, supplies, and equipment heretofore or hereafter purchased or acquired for the construction of the Panama Canal is no longer needed, or is no longer serviceable, it may be sold in such manner as the President may direct, and without advertising in such classes of cases as may be authorized by him.

\* \* \* \* \*

Approved, May 1, 1913.

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AN ACT Providing certain legislation for the Panama California Exposition to be held in San Diego, California, during the year nineteen hundred and fifteen.

*Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Secretary of the Treasury be, and he is hereby, authorized and directed to require the Panama California Exposition Company, of San Diego, California, to deposit with a depository, to be named by the Secretary of the Treasury, such sum or sums of money as in the discretion of the Secretary shall be necessary to cover awards, medals, certificates, prizes, and premiums, and all other obligations incurred by said corporation with exhibitors at the Panama California Exposition, which money shall be held by said depository as a pledge to the United States Government for a faithful fulfillment of the above obligations; or the Secretary of the Treasury may, in lieu of such cash pledge, accept a good and sufficient bond from said exposition company, to be approved by him and conditioned for the faithful performance of every liability or obligation incurred by said exposition company in respect to exhibitors at said exposition, to be held in San Diego, California, during the year nineteen hundred and fifteen.*

SEC. 2. That all articles that shall be imported from foreign countries for the sole purpose of exhibition at the Panama California Exposition upon which there shall be a tariff or customs duty shall be admitted free of the payment of duty, customs fees, or charges, under such regulations as the Secretary of the Treasury shall prescribe; but it shall be lawful at any time during the exposition to sell, for delivery at the close thereof, any goods or property imported for and actually on exhibition in the exposition buildings or on the grounds, subject to such regulations for the security of the revenue and for the collection of import duties as the Secretary of the Treasury may prescribe: *Provided*, That all such articles when sold or withdrawn for consumption or use in the United States shall be subject to the duty, if any, imposed upon such articles by the revenue laws in force at the date of withdrawal; and on such articles which shall have suffered diminution or deterioration from incidental handling and necessary exposure, the duty, if paid, shall be assessed according to the appraised value at the time of withdrawal for consumption or use, and the penalties prescribed by law shall be enforced against any person guilty of any illegal sale, use, or withdrawal.

Approved, May 22, 1913.

AN ACT Making appropriations for sundry civil expenses of the Government for the fiscal year ending June thirtieth, nineteen hundred and fourteen, and for other purposes.

*Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled*, That the following sums be, and the same are hereby, appropriated, for the objects hereinafter expressed, for the fiscal year ending June thirtieth, nineteen hundred and fourteen, namely:

\* \* \* \* \*

# THE PANAMA CANAL.

To continue the construction of the Panama Canal, to be expended under the direction of the President, in accordance with an Act entitled "An Act to provide for the construction of a canal connecting the waters of the Atlantic and Pacific Oceans," approved June twenty-eighth, nineteen hundred and two, and Acts amendatory thereof or supplementary thereto:

First. For salaries of officers and employees of the Isthmian Canal Commission, including assistant purchasing and shipping agents, and all other employees in the United States, \$153,393;

Second. For incidental expenses, including rents, cable and telegraph service, supplies, stationery and printing, and actual necessary traveling expenses in the United States (including rent of the Panama Canal building in the District of Columbia, \$7,500, textbooks and books of reference, \$1,000, and additional compensation to the Auditor for the War Department for extra services in auditing accounts of the Panama Canal, \$1,000), \$63,000;

Third. For pay of members of the commission and officers and employees on the Isthmus, other than skilled and unskilled labor, including civil engineers, superintendents, instrumentmen, transitmen, levelmen, rodmen, draftsmen, timekeepers, mechanical and electrical engineers, quartermasters, clerks, accountants, stenographers, storekeepers, messengers, office boys, foremen and subforemen, wagon masters, watchmen, and stewards, including those temporarily detailed for duty away from the Isthmus, in the departments of construction and engineering, quartermaster's, subsistence, disbursements and examination of accounts, and for those employed in connection with the preservation of plans, drawings, and other records, \$2,725,000: *Provided*, That not more than \$5,000 of this appropriation shall be paid as compensation to the secretary of the commission;

Fourth. For skilled and unskilled labor on the Isthmus, including engineers, conductors, firemen, brakemen, electricians, teamsters, cranesmen, machinists, blacksmiths, and other artisans, and their helpers; janitors, sailors, cooks, waiters, and dairymen, for the departments of construction and engineering, quartermaster's, subsistence, disbursements and examination of accounts, \$6,125,000;

Fifth. For the purchase and delivery of material, supplies, and equipment, including cost of inspecting material and of paying traveling expenses incident thereto, whether on the Isthmus or elsewhere, and such other expenses not in the United States as the commission deems necessary to best promote the construction of the Panama Canal, including the construction in the United States in Government or private yards, in accordance with plans and specifications to be prepared by the Navy Department, and to have a cargo capacity of twelve thousand tons of coal and a speed

of at least fourteen knots per hour, two colliers to cost not exceeding \$1,000,000 each, and including the payment of damages caused to the owners of private lands, or private property of any kind, by reason of the grants contained in the treaty between the United States and the Republic of Panama proclaimed February twenty-sixth, nineteen hundred and four, or by reason of the operations of the United States, its agents or employees, or by reason of the construction, maintenance, operation, sanitation, and protection of the said canal or of the works of sanitation and protection therein provided for, whether compromised by agreement between the claimant and the chairman of the commission or allowed by a joint commission, and the payment for land and land under water as authorized in section three of the Panama Canal Act, for the departments of construction and engineering, quartermaster's, subsistence, disbursements and examination of accounts, \$5,000,000;

Sixth. For miscellaneous expenditures, cable and telegraph service, stationery and printing, local railway transportation, special trains, including pay-train service; transportation of currency to the Isthmus, recruiting and transporting laborers, transporting employees from the United States, repatriating laborers and employees, actual necessary traveling expenses while on the Isthmus on official business; expenses incident to conducting hearings and examining estimates for appropriations on the Isthmus, and all other incidental and contingent expenses not otherwise provided for, for the departments of construction and engineering, quartermaster's, subsistence, disbursements and examination of accounts, \$725,000;

Seventh. For pay of the member of the commission in charge of the department of civil administration, of officers and employees, other than skilled and unskilled labor, including foremen, subforemen, watchmen, messengers, and storekeepers, of the departments of civil administration and law, including those necessarily and temporarily detailed for duty away from the Isthmus, together with the necessary portion of such sums as shall be paid as water rentals or directly by the Government of Panama for the maintenance of waterworks, sewers, and pavements in the cities of Panama and Colon, \$500,000;

Eighth. For skilled and unskilled labor for the department of civil administration, the necessary portion of such sums as shall be paid as water rentals or directly by the Government of Panama for the maintenance of waterworks, sewers, and pavements in the cities of Panama and Colon.

Ninth. For material, supplies, equipment, construction and repairs of buildings, and contingent expenses of the departments of civil administration and law, including not exceeding \$500 for law books, together with the necessary portion of such sums as shall be paid as water rentals or directly by the Government of Panama for the maintenance of waterworks, sewers, and pavements in the cities of Panama and Colon, \$74,000.

Tenth. For pay of the member of the commission in charge, of officers and employees other than skilled and unskilled labor, including hospital dispensers, internes, nurses, attendants, messengers, office boys, foremen and subforemen, watchmen, and stewards, of the department of sanitation on the Isthmus, including those temporarily detailed for duty away from the Isthmus, \$450,000;

Eleventh. For skilled and unskilled labor of every grade and kind, for the department of sanitation on the Isthmus, \$150,000;

Twelfth. For materials, supplies, equipment, construction and repairs of buildings, medical aid and support of the insane, and of indigent persons permanently disabled, while in the line of duty and in the employ of the Isthmian Canal Commission, from earning a livelihood, and contingent expenses of the department of sanitation on the Isthmus, including not exceeding \$100,000 for the construction of a quarantine station, \$300,000;

The foregoing sums, so far as necessary, shall be available for the operation of the canal, for the permanent organization authorized to be established under the Panama Canal Act, for dry docks, repair shops, yards, docks, wharves, warehouses, storehouses, and other necessary facilities and appurtenances for the purpose of providing coal and other materials, labor, repairs and supplies, for office buildings, quarters, and other necessary buildings, for the payment of claims arising out of injuries or deaths of employees, and for the consolidation and preservation of the files of papers and other records which have accumulated or may accumulate during the construction of the canal and needed or useful or having a permanent value or historical interest;

In all, \$16,265,393, the same to be immediately available and to continue available until expended: *Provided*, That all expenditures from the appropriations heretofore, herein, and hereafter made for the construction of the Panama Canal, including any portion of such appropriations which may be used for the construction of dry docks, repair shops, yards, docks, wharves, warehouses, storehouses, and other necessary facilities and appurtenances for the purpose of providing coal and other materials,

labor, repairs, and supplies, for the construction of office buildings and quarters, and other necessary buildings, exclusive of fortifications, and exclusive of the amount used for operating the canal and for the permanent organization after the canal is opened for use and operation, shall be paid from or reimbursed to the Treasury of the United States out of the proceeds of the sale of bonds authorized in section eight of the said Act approved June twenty-eighth, nineteen hundred and two, and section thirty-nine of the tariff Act approved August fifth, nineteen hundred and nine.

Except in cases of emergency, or conditions arising subsequent to and unforeseen at the time of the passage of this Act, and except for those employed in connection with the construction of permanent quarters, offices and other necessary buildings, dry docks, repair shops, yards, docks, wharves, warehouses, storehouses, and other necessary facilities and appurtenances, for the purpose of providing coal and other materials, labor, repairs and supplies, and except for the permanent operating organization under which the compensation of the various positions is limited by section four of the Panama Canal Act, there shall not be employed at any time during the fiscal year nineteen hundred and fourteen under any of the foregoing appropriations for the Panama Canal, any greater number of persons than are specified in the notes submitted respectively in connection with the estimates for each of said appropriations in the annual Book of Estimates for said year, nor shall there be paid to any of such persons during that fiscal year any greater rate of compensation than was authorized to be paid to persons occupying the same or like positions on the first day of July, nineteen hundred and twelve; and all employments made or compensation increased because of emergencies or conditions so arising shall be specifically set forth, with the reasons therefor, by the chairman of the commission in his report for the fiscal year nineteen hundred and fourteen.

In cases of emergencies arising subsequent to and unforeseen at the time of submitting the annual estimates to Congress, ten per centum of the foregoing amounts shall be available interchangeably for expenditure on objects named; but not more than ten per centum shall be added to any one item of the appropriation.

No part of the foregoing appropriations for the Panama Canal shall be applied to the payment of allowances for longevity service, or lay-over days other than such as may have accumulated under existing orders of the commission, prior to July first, nineteen hundred and nine.

#### FORTIFICATIONS, PANAMA CANAL.

For the following for fortifications and armament thereof for the Panama Canal, to be immediately available and to continue available until expended, namely:

Surveys: For detailed surveys of the areas on the Canal Zone required for military purposes, including the cost of marking permanently the boundaries of such areas, \$12,000;

Purchase of land: For the purchase of land on the Canal Zone required for military purposes, \$50,000;

Seacoast batteries: For the construction of seacoast batteries on the Canal Zone, \$2,365,000;

Electric light and power plants: For the purchase and installation of electric light and power plants for the seacoast fortifications on the Canal Zone, \$173,000;

Searchlights: For the purchase and installation of searchlights for the seacoast fortifications on the Canal Zone, \$285,000;

Sanitary clearing: For sanitary clearing, filling, and drainage in vicinity of camps, posts, and defensive works on the Canal Zone, as follows:

Margarita Island: For filling swamp in rear defensive works, \$180,000;

For clearing and improving permanent post site and drill ground at Miraflores, \$30,000;

Armament of fortifications: For the purchase, manufacture, and test of seacoast cannon for coast defense, including their carriages, sights, implements, equipments, and the machinery necessary for their manufacture at the arsenals, to cost ultimately not to exceed \$2,506,000, \$1,000,000: *Provided*, That the Chief of Ordnance is authorized to transfer to and use in the fortifications of the Panama Canal one sixteen-inch gun and carriage, procured, or to be procured, out of appropriations heretofore made under armament of fortifications for continental United States;

For the purchase, manufacture, and test of ammunition for seacoast cannon, including the necessary experiments in connection therewith, and the machinery necessary for its manufacture at the arsenals, \$75,000;

Fire control: For the construction of fire-control stations and the purchase and installation of accessories therefor, \$200,000;

In all, specifically for fortifications and armament thereof for the Panama Canal, \$4,870,000.

The Secretary of War is authorized and directed to cause to be prepared and submit to Congress on or before December fifteenth, nineteen hundred and thirteen, complete plans for, and detailed estimates of, barracks and quarters for the mobile army and seacoast artillery on the Canal Zone and in the Hawaiian Islands.

SEC. 2. That all funds collected by the government of the Canal Zone from rentals of public lands and buildings in the Canal Zone and the cities of Panama and Colon, and from the zone postal service, and from court fees and fines, and collected or raised by taxation in whatever form under the laws of the government of the Canal Zone, are hereby appropriated until and including June thirtieth, nineteen hundred and fourteen, as follows: The revenues derived from the postal service to the maintenance of that service; the remaining revenues, including any balances unexpended in prior years, after setting aside a miscellaneous and contingent fund of not exceeding ten thousand dollars, to the maintenance of the public-school system in the zone; to the construction and maintenance of public improvements within the zone; to the maintenance of the administrative districts; and for the expenses of the subdivisions of the Canal Zone after they are established under section seven of the Panama Canal Act; to the maintenance of Canal Zone charity patients in the hospitals of the Isthmian Canal Commission, and to the maintenance of administrative district prisoners. A detailed and classified statement of all receipts and expenditures without the duplication of items under this paragraph shall be submitted to Congress after the close of the fiscal year nineteen hundred and fourteen.

SEC. 3. That hereafter the head of each executive department and other Government establishment shall, on or before July first in every fiscal year, designate from among the officials employed therein one person whose duty it shall be to supervise the classification and compilation of all estimates of appropriations, including supplemental and deficiency estimates to be submitted by such department or establishment. In the performance of their duties persons so designated shall have due regard for the requirements of all laws respecting the preparation of estimates, including the manner and time of their submission through the Treasury Department to Congress; they shall also, as nearly as may be practicable, eliminate from all such estimates unnecessary words and make uniform the language commonly used in expressing purposes or conditions of appropriations.

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SEC. 6. That all sums appropriated by this Act for salaries of officers and employees of the Government shall be in full for such salaries for the fiscal year nineteen hundred and fourteen, and all laws or parts of laws in conflict with the provisions of this Act are repealed.

SEC. 7. That section eight of the District of Columbia appropriation Act, approved June twenty-sixth, nineteen hundred and twelve, shall not take effect or be operative during the fiscal year nineteen hundred and fourteen except to the extent that it prohibits the payment of membership fees or dues in societies or associations: *Provided*, That during the fiscal year nineteen hundred and fourteen expenses of attendance of officers or employees of the Government at any meeting or convention of members of any society or association shall be incurred only on the written authority and direction of the heads of executive departments or other Government establishments or the Government of the District of Columbia; and a detailed statement of all such expenses incurred from June thirtieth until December first, nineteen hundred and thirteen, shall be submitted to Congress on or before January first, nineteen hundred and fourteen.

## TO PROVIDE FOR THE PARTICIPATION OF THE UNITED STATES IN THE PANAMA-PACIFIC INTERNATIONAL EXPOSITION.

There shall be exhibited at the Panama-Pacific International Exposition, to be held at San Francisco in nineteen hundred and fifteen, such articles and materials as illustrate the function and administrative faculty of the Government of the United States tending to demonstrate the nature and growth of our institutions, their adaptation to the wants of the people, and the progress of the Nation in the arts of peace and war; and the President is authorized to provide for the collection and exhibition of such articles and materials under the direction of a board, which is hereby created, to be known as the Government Exhibit Board, which shall be composed of three members to be named by the President from persons in the executive departments, who after consultation with the heads of the executive departments and the Regents

of the Smithsonian Institution, the Isthmian Canal Commission, the Interstate Commerce Commission, the Civil Service Commission, the Commissioners of the District of Columbia, the American National Red Cross, the Commission of Fine Arts, the Librarian of Congress, the Public Printer, the Governor of Porto Rico, the Governor of Alaska, the Governor of Hawaii, and the United States Geographic Board, shall determine, the nature, character, and extent of the exhibits to be made, and shall be charged with the selection, purchase, preparation, safe-keeping, exhibition, and return of such articles and materials as said board may decide shall be exhibited. Before any obligations are incurred of any nature, said board shall have arranged the scope of such exhibits so as to provide for the collection, exhibition, and return of such articles and materials at a cost, which together with all other expenses herein authorized, shall not exceed the amount hereinafter appropriated. The President shall designate one member of said board as chairman, and from persons in the employ of the United States Government may designate a secretary and a disbursing officer for said board, and may also detail such other persons, including officers of the Army and Navy as he may deem necessary to assist said board. All officers and employees of the Government who may be detailed as aforesaid shall receive no compensation in addition to their regular salaries, but shall be allowed their actual and necessary traveling expenses, together with a per diem in lieu of subsistence, to be fixed by the Secretary of the Treasury, but in no case to exceed \$5 per day while necessarily absent from their homes engaged upon the business of the board. Any officer of the Army or Navy so detailed shall receive this allowance in lieu of the transportation and mileage now allowed him by law. Any provision of law which may prohibit the detail of persons, in the employ of the United States to other service than that which they customarily perform, shall not apply to persons detailed to duty in connection with said Panama-Pacific International Exposition. Employees of the board not otherwise employed by the Government shall be entitled to such compensation as the board may determine: *Provided*, That compensation shall not be paid to any such employee at a rate in excess of \$3,000 per annum. The disbursing officer shall give bond in the sum of \$30,000 for the faithful performance of his duties, said bond to be approved by the Secretary of the Treasury. The Secretary of the Treasury shall advance to said officer from time to time, under such regulations as the Secretary of the Treasury may prescribe, a sum of money from the appropriation herein made for the governmental participation in the exposition, not exceeding at any one time the penalty of his bond, to enable him to pay the expenses of exhibition as authorized by the exhibit board.

Suitable buildings for the housing of all said exhibits shall be provided by the Panama-Pacific International Exposition Company without expense of any kind to the Government of the United States.

For the purpose of inaugurating, installing, maintaining, and returning said Government exhibits, together with all other expenses of every kind connected therewith, \$500,000. Said sum shall be paid by the Secretary of the Treasury from time to time under such regulations as he may prescribe.

The President of the United States is authorized to detail three civilian officers or employees from the executive departments as members of a commission which is hereby constituted as the National Exposition Commission, one of said commissioners who shall be the chairman of said commission, shall be detailed from the Department of State. Vacancies in said commission shall be filled in the same manner as original appointments. Each commissioner shall receive in addition to his original compensation his actual necessary traveling expenses and an allowance of \$10 per day in lieu of subsistence. Said commissioners may appoint a secretary at \$2,500 per annum, and the sum of \$15,000, or so much thereof as may be necessary, may be expended for clerical, office, and other necessary and actual expenses of said commission.

Said commission shall be authorized and empowered to act as a board of arbitration to settle and determine any and all disputes arising between the commissioners of foreign Governments and the directors of said Panama-Pacific International Exposition, whenever a formal request for such action is made by any foreign commissioner; and said National Exposition Commission shall represent the Government of the United States at said exposition in the reception and care of persons officially representing foreign Governments.

Said National Exposition Commissioners shall be detailed not earlier than July first, nineteen hundred and fourteen, and their term of service as said commissioners shall not extend beyond July first, nineteen hundred and sixteen, and the President may terminate said commission at any time after January first, nineteen hundred and sixteen.

Approved June 23, 1913.

## EXECUTIVE ORDER No. 1.

*Consolidating the Administrative District of Gorgona with that of Empire, and for other purposes.*

By virtue of the authority vested in me I hereby establish the following order for the Canal Zone:

SECTION 1. The Administrative District of Emperador shall be known hereafter as the Administrative District of Empire, and the town of Empire shall be the head of the District.

SEC. 2. The Administrative District of Gorgona is hereby abolished, and the territory heretofore embraced in said District is incorporated into the Administrative District of Empire for all judicial, administrative, and political purposes.

SEC. 3. The District Court of Gorgona is hereby abolished, and all cases, civil or criminal, pending in said court, at the time this order takes effect are transferred to the District Court of Empire, to be tried and disposed of in said court in like manner and form as if they had been originally instituted therein, without prejudice to any rulings or orders that may have been previously made in said cases by the District Court of Gorgona; and all process issued in said cases made returnable to the District Court of Gorgona shall be returnable to the District Court of Empire, and the records and files of the District Court of Gorgona shall be transferred to and become a part of the records and files of the District Court of Empire as soon as this order takes effect.

SEC. 4. If at any time it is impracticable to assign a district judge of one district to hold the court of another district judge, the Head of the Department of Civil Administration, with the approval of the Chairman of the Isthmian Canal Commission, shall appoint some competent person to act as a special judge to hold such court until the regular judge thereof returns to his duties, or one of the district judges is assigned to such court under the existing laws. Any person appointed special judge hereunder, while serving in that capacity shall receive compensation for his services at the same rate as that paid to the regular district judge.

SEC. 5. The powers and duties heretofore vested in and imposed on the administrative officers of the District of Gorgona are hereby transferred to the corresponding administrative officials respectively in the District of Empire; together with the records and files belonging to such officers.

SEC. 6. The areas of Gatun Lake lying outside of the east and west lines of the Canal Zone proper (original ten mile strip) and the lands adjacent to said areas up to contour lines of one hundred feet above mean sea level, are hereby included in the present Cristobal Administrative District, and in the Third Judicial Circuit, for all judicial, administrative, and political purposes; except, that part of the Chagres and its confluences from the point where the said river intersects the eastern line of the Canal Zone proper, thence to the eastward up to contour lines of one hundred feet above mean sea level, which shall be included in the Administrative District of Empire and in the Second Judicial Circuit for such purposes.

SEC. 7. All laws and orders or parts thereof in conflict with this order are hereby repealed.

SEC. 8. This order shall take effect ten days from and after this date; *Provided*, That the office of senior district judge in accordance with the preexisting laws shall continue until December 31, 1912, at which date the said office shall cease to exist; *And, provided further*, That nothing in this order shall be construed to deprive any judicial or administrative officer of the District of Gorgona as now formed, of leave of absence with pay that may be due him when this order takes effect.

WM. H. TAFT.

THE WHITE HOUSE,  
September, 12, 1912.

## EXECUTIVE ORDER No. 2.

By virtue of the authority vested in me by the Act of Congress entitled "An Act to provide for the opening, maintenance, protection and operation of the Panama Canal and the sanitation and government of the Canal Zone," approved August 24, 1912, I hereby declare that all land and land under water within the limits of the Canal Zone are necessary for the construction, maintenance, operation, protection and sanitation of the Panama Canal, and the Chairman of the Isthmian Canal Commission is hereby directed to take possession, on behalf of the United States, of all such land



and land under water; and he may extinguish, by agreement when practicable, all claims and titles of adverse claimants to the occupancy of said land and land under water.

WM H TAFT

THE WHITE HOUSE,  
December 5th, 1912.

[Panama Canal toll rates.]

BY THE PRESIDENT OF THE UNITED STATES OF AMERICA.

### A PROCLAMATION.

I, WILLIAM HOWARD TAFT, President of the United States of America, by virtue of the power and authority vested in me by the Act of Congress, approved August twenty-fourth, nineteen hundred and twelve, to provide for the opening, maintenance, protection and operation of the Panama Canal and the sanitation and government of the Canal Zone, do hereby prescribe and proclaim the following rates of toll to be paid by vessels using the Panama Canal:

1. On merchant vessels carrying passengers or cargo one dollar and twenty cents (\$1.20) per net vessel ton—each one hundred (100) cubic feet—of actual earning capacity.

2. On vessels in ballast without passengers or cargo forty (40) percent less than the rate of tolls for vessels with passengers or cargo.

3. Upon naval vessels, other than transports, colliers, hospital ships and supply ships, fifty (50) cents per displacement ton.

4. Upon army and navy transports, colliers, hospital ships and supply ships one dollar and twenty cents (\$1.20) per net ton, the vessels to be measured by the same rules as are employed in determining the net tonnage of merchant vessels.

The Secretary of War will prepare and prescribe such rules for the measurement of vessels and such regulations as may be necessary and proper to carry this proclamation into full force and effect.

In witness whereof, I have hereunto set my hand and caused the seal of the United States to be affixed.

Done at the City of Washington this thirteenth day of November in the year of our Lord one thousand nine hundred and twelve and of the independence of the United States the one hundred and thirty-seventh.

WM H TAFT

By the President:

P C KNOX

Secretary of State.

### EXECUTIVE ORDER No. 3.

*To Amend the Executive Order Providing for the Inspection of Steam Vessels, Approved July 21, 1911.*

By virtue of the authority vested in me, I hereby establish the following Order for the Canal Zone:

SECTION 1. Section 10 of the Executive Order entitled "Executive Order Providing for the Inspection of Steam Vessels," approved July 21, 1911, is hereby amended to read as follows:

SECTION 10. Before issuing an inspection certificate to any vessel, the Collector of Revenues shall demand and receive from the owner or master of such vessel the following compensation for inspection and examination made for the year, in addition to any fees for issuing enrollments and licenses now, or which may hereafter be, allowed by law:

For each steam vessel under 15 gross tons.....	\$5. 00
For each steam vessel over 15 gross tons and not exceeding 100 gross tons.....	10. 00
For each and every gross tons in excess of 100 gross tons.....	.05

The fees herein provided for shall cover the cost of the certificate, as well as the cost of inspection and examination of the vessel, and shall be for the use and benefit of the Canal Zone Government.

SECTION 2. Section 18 of the above-mentioned Executive Order is hereby amended so as to read as follows:

SECTION 18. Every vessel coming within the provisions of this Order shall be provided with such number of lifeboats, floats, rafts, life-preservers, line carrying projectiles and best means of propelling them, lights, drags, anchors, and with such other equipment, as, in the judgment of the Board of Local Inspectors, will best procure the safety of all persons on board such vessels in case of disaster. And every such vessel shall have the lifeboats required by this Order provided with suitable boat disengaging apparatus, so arranged as to allow such boats to be safely launched while such vessels are under speed, or otherwise, so as to allow such disengaging apparatus to be operated by one person, disengaging both ends of the boat simultaneously from the tackle by which it may be lowered to the water; and the Board of Local Inspectors shall determine the kind of lifeboats, floats, rafts, life-preservers, line carrying projectiles and means of propelling the same, lights, drags, anchors, and other equipment which are to be used on the vessel; and also the kind and capacity of the pumps for freeing the vessel from water in case of heavy leakage, the capacity of such pumps being suited to the navigation in which the vessel is employed.

SECTION 3. This order shall take effect thirty days from this date.

WM H TAFT

THE WHITE HOUSE,  
*January 13, 1913.*

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#### EXECUTIVE ORDER NO. 4.

By virtue of the authority vested in me I hereby order that all that area of land in the Canal Zone known as Las Sabanas be excepted from the provisions of the Executive Order of December 5, 1912, directing the Chairman of the Isthmian Canal Commission to take possession on behalf of the United States of all privately owned lands in the Canal Zone, the said area being bounded on the south by the present limits of the City of Panama, on the southeast by the Pacific Ocean, on the northeast by the boundary line of the Canal Zone from monument 99 for a distance of four thousand seven hundred and forty-four and five-tenths (4744-5/10) meters to monument marked "F", on the northwest by a line extending from said monument F south 63 degrees 32 minutes west for a distance of two thousand and eight and six-tenths (2008-6/10) meters to the intersection of said line with the Curundu River, and on the west by the Curundu River from said point of intersection to the point where said river crosses the present boundary line of the City of Panama.

WM H TAFT

THE WHITE HOUSE,  
*February 18, 1913.*

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#### EXECUTIVE ORDER NO. 5.

All artisans, citizens of the United States, who are now or may hereafter be in the service of the Isthmian Canal Commission and who have rendered one year's satisfactory service on the Isthmus of Panama, and who may be recommended, upon discharge, for transfer, may be transferred within three years to corresponding positions in the classified service under the several Executive Departments and independent Government establishments, without examination, subject to the other provisions of the civil service rules.

WM H TAFT

THE WHITE HOUSE,  
*February 18th, 1913.*

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#### EXECUTIVE ORDER NO. 6.

*Providing for the Protection of Birds and their Nests In the Canal Zone.*

By virtue of the authority vested in me, I hereby establish the following Executive Order for the Canal Zone:

SECTION 1. It shall be unlawful for any person to hunt, trap, capture, wilfully disturb or kill any bird of any kind whatever, or to take the eggs of any bird, except in the form and manner permitted by the regulations provided for by this Order.

SEC. 2. The Isthmian Canal Commission, or the Governor of the Panama Canal after the reorganization is established, is hereby empowered and directed to enact suitable regulations, from time to time, for the protection of birds and their nests,

and prescribing the form and manner in which birds may be hunted, and the kinds of birds that may be hunted, and those that shall not be molested.

SEC. 3. A violation of any of the regulations established under this Order shall be punished by a fine of not more than one hundred (100) dollars or by imprisonment for not more than thirty days for each offense.

SEC. 4. This Order shall take effect thirty days after its publication in THE CANAL RECORD.<sup>1</sup>

WOODROW WILSON.

THE WHITE HOUSE,  
19 March, 1913.

#### EXECUTIVE ORDER No. 7.

*To Provide an Inexpensive Method for the Administration of Estates of Deceased and Insane Persons in Certain Cases, and to Repeal Act 24, of the Canal Zone Laws, and the Executive Orders Amendatory Thereto.*

By virtue of the authority invested in me, I hereby establish the following Executive Order for the Canal Zone:

SECTION 1. Whenever an employee in the service of the Isthmian Canal Commission, or of the Government of the Canal Zone, or of the Panama Rail Road Company, shall die, leaving an estate in the said Zone, or whenever such decedent, being a citizen of the United States, leaves an estate in the Canal Zone or in the Republic of Panama; and the said estate consists of personal property only and a regular administration shall not have been instituted in the Courts of the Canal Zone thereon, the Collector of Revenues for the Canal Zone is hereby authorized and directed to take possession of the estate of the said deceased person and to make a complete inventory thereof and present the same to the Judge of the Circuit Court of the First Judicial Circuit of the Canal Zone, to be filed by the said Judge in the records of his court when approved by him.<sup>2</sup>

SEC. 2. The Collector of Revenues, with the approval of the Judge of the Circuit Court of the First Judicial Circuit, out of the assets of the estate, may pay the burial expenses of the said deceased person and all expenses necessarily incurred in securing possession of the estate and of administering the same until it is turned over to the heirs or other parties entitled thereto, and he may also pay the expenses of the transportation of the remains of the decedent to the United States, if he is an American citizen and such transportation is desired by the surviving relatives. He shall also pay the lawful debts of the deceased, with the approval of the Circuit Judge.

SEC. 3. In case the deceased shall have to his credit with the Isthmian Canal Commission, the Government of the Canal Zone, or the Panama Rail Road Company, any sum as salary or other acknowledged claim, the amount so due shall be paid to the Collector of Revenues and be by him administrated as a part of said estate in the manner prescribed by this Order; *Provided*, That if there should be a regular administration upon the estate of the deceased in a court of competent jurisdiction of the Canal Zone, then the sum due to the deceased shall be paid to the regular executor or administrator of the estate appointed by said court.

SEC. 4. After all the expenses connected with the burial of the deceased person and in securing possession of the estate and in otherwise administering the same, together with the lawful debts of the deceased, have been fully paid, the balance of such estate shall be paid by the Collector of Revenues to the parties entitled to receive such estate; but before making such payment, the approval of the Judge of the Circuit Court must be obtained.

SEC. 5. If the deceased employee is an alien and has no heirs in the Canal Zone, the Collector of Revenues is hereby authorized and directed to deliver the residue of the decedent's estate to the diplomatic or consular representative of the country of which the decedent was a citizen or subject accredited to the Republic of Panama, to be delivered by such representative to the heirs of the decedent; if the deceased is a citizen of Panama, the residue of the estate may be delivered to his heirs in Panama, or to the authorities designated for that purpose by the Panamanian laws or decrees.

SEC. 6. After the estate has been fully administered by the Collector of Revenues and the residue thereof has been turned over to the parties entitled to the same according to this Order, the Collector of Revenues shall file a final report of his acts and doings in the estate with the Judge of the Circuit Court, and accompany said report with the proper vouchers and other supporting papers, showing the receipts and disbursements made by him in administering the estate, and the Circuit Judge shall

<sup>1</sup> Published in THE CANAL RECORD of April 9, 1913.

<sup>2</sup> This section reads as amended by Executive Order of March 20, 1913 (C. Z. No. 62), effective that date.

examine said report, and if he finds it correct, he shall approve the same and discharge the Collector of Revenues as such administrator.

SEC. 7. If the decedent should leave a widow, or minor children, or dependent relative in necessitous circumstances, to be determined by the Circuit Judge, the residue of the estate of the decedent, after all of the funeral expenses, the expenses of transportation of the remains of the deceased to the United States, if the remains are transported, and the other expenses incident to the administration of the estate are fully paid, shall be delivered to said widow, or minor children, or dependent relative, as the case may be, for their maintenance and support; and, except as in this section otherwise provided, the claims of the widow, minor children, or dependent relative of the deceased for this allowance shall be superior to the claims of the creditors of the deceased: *Provided*, That such preference in favor of the widow, minor children, or dependent relative shall not exceed \$500.

SEC. 8. *If an employee of the Isthmian Canal Commission, the Government of the Canal Zone, or the Panama Rail Road Company should be adjudged insane by the Canal Zone Courts and the estate consists entirely of personal property and no regular guardianship of such estate shall have been instituted by the Canal Zone courts, it shall be the duty of the Collector of Revenues to take possession of the estate of such insane person, including any salary or other acknowledged claim due to such employee by the Isthmian Canal Commission, the Canal Zone Government or the Panama Rail Road Company, and make a complete inventory thereof and file the same with the Judge of the Circuit Court of the First Judicial Circuit of the Canal Zone, and under the direction and with the approval of the Judge of said court, the Collector of Revenues may pay the lawful indebtedness due by the insane person, as well as the expenses incurred in administering the said estate and he shall hold the residue of the estate subject to the orders of the Circuit Judge.*<sup>1</sup>

If the insane person has a wife, minor child or children, or dependent relative, in necessitous circumstances, to be determined by the Circuit Judge, the Court shall set aside a sufficient sum out of the said estate for their maintenance and support, not to exceed the sum of \$500 in the aggregate, to be paid in such manner and at such times as the Circuit Judge may prescribe, and which allowance shall be superior to all other claims against the estate; and the order of the Judge shall be sufficient authority for the Collector of Revenues to make such payment, taking proper receipts therefor.

In case the insane person is a citizen of the United States and has no wife, child or children, or dependent relative, the Collector of Revenues shall retain possession of the residue of said estate, after the debts and other charges have been paid as above mentioned, and hold same subject to the orders of the Court.

If the insane person is a Panamanian and has no wife, child or children, or dependent relative, the residue of the estate, with the approval of the Circuit Judge, may be delivered by the Collector of Revenues to the authorities designated for that purpose by the Panamanian laws or decrees.

If the insane person is an alien, other than a Panamanian, and has no wife, child or children, or dependent relative, the Collector of Revenues, with the approval of the Judge of the Circuit Court, shall pay over the residue of the said estate to the diplomatic or consular representative of the country to which the insane person belongs accredited to the Republic of Panama, to be disposed of by him in accordance with the laws of his country.

SEC. 9. When the estate of the insane person is finally administered and the moneys paid over to the person or persons entitled to receive same as herein provided for, the Collector of Revenues shall make his final report on said estate to the Judge of the Circuit Court and the Court shall approve the same if found to be correct, and discharge the Collector of Revenues from such guardianship.

SEC. 10. When the Collector of Revenues shall have performed his duties in accordance with the provisions of this Order and shall have delivered the estate or paid over the sums due from the funds of said estate to the person or persons entitled thereto in accordance with the orders of the Court, such settlement of the estate shall be deemed a lawful settlement thereof, and the Collector of Revenues shall not be accountable on his bond and shall not be liable to any other person for the estate so administered by him: *Provided*, That nothing in this Order shall prohibit the lawful heirs or claimants of any person whose estate has been settled in accordance with the provisions of this Order from bringing suit in any court having jurisdiction of the subject matter and of the parties to the action against the person or persons who received the estate by virtue of the provisions of this act, and from recovering the same or the value thereof from such person or persons upon proof that the estate has been delivered to the persons not entitled to receive and retain same.

<sup>1</sup> This section reads as amended by the Executive Order of March 20, 1913 (C. Z. No. 62), effective that date.

SEC. 11. This Order shall apply to the estate of persons who died or became insane prior to the passage of the Order, as well as to those who die or become insane after the date of its promulgation.

SEC. 12. If the Collector of Revenues shall deem it to the best interest of the estate of the deceased or insane person to convert any part or all of the property of the estate into cash, he may dispose of the same by public or private sale, with the approval of the Circuit Judge.

SEC. 13. The proceedings to be had before the Judge of the Circuit Court as herein provided for may be conducted without the necessity of any prior notice being given of the same, either by publication or otherwise; and the judge may proceed in such cases in open court or in chambers, and shall give precedence to such matters over all other business pending before him, in order that the estates may be administered and closed as expeditiously as the rights of all parties concerned may permit. No court costs of any kind shall be taxed against estates administered under the provisions of this Order.

SEC. 14. The official bond of the Collector of Revenues shall be security for the moneys and properties received by him in the performance of the duties prescribed for him by this Order.

SEC. 15. Act 24, of the Canal Zone Laws, entitled:

"An Act providing for an inexpensive method of Administration upon the Estates of Employees of the Government of the Canal Zone, or of the Isthmian Canal Commission, who are citizens of the United States and who die in the Canal Zone, Isthmus of Panama, leaving estates of small value upon which regular administration is deemed inadvisable."

enacted March 1, 1905, and Executive Order dated June 22, 1907, effective July 1, 1907, and Executive Order dated July 21, 1909, respectively, amendatory of said Act 24, and all laws in conflict herewith, are hereby repealed.

SEC. 16. This Order shall take effect 30 days from and after this date.

WM. H. TAFT.

THE WHITE HOUSE,

February 5, 1912.

NOTE.—Sections 2 and 8 read as amended by the Executive Order of March 20, 1913 (C. Z. No. 62), effective that date. Section 11 of that Order reads as follows:

"Section 11. This amendment shall apply to the estates of employees who died or became insane prior to this date as well as to those who die or are adjudged insane hereafter."

## EXECUTIVE ORDER NO. 8.

### *Relating to Foreign Corporations.*

By virtue of the authority vested in me, I hereby establish the following Order for the Canal Zone:

SECTION 1. No corporation or joint stock company (other than insurance companies) organized under the laws of any State or Territory of the United States or of any foreign government shall do business in the Canal Zone until after it has filed in the office of the Collector of Revenues a duly authenticated copy of its charter or articles of incorporation, as well as a statement, verified by the oath of the president or secretary of said corporation and attested by a majority of its board of directors, showing:

1. The name of such corporation and the location of its principal office or place of business outside of the Canal Zone; and if it is to have any place of business or principal office within the Canal Zone, the location thereof.

2. The amount of its capital stock.

3. The amount of its capital stock actually paid in, in money, and the amount of its capital stock paid in, in any other way, and in what way the payment was made.

4. The amount of assets of the corporation and in what the assets consist, and the actual cash value thereof.

5. The liabilities of such corporation and if any of its indebtedness is secured, how secured, and upon what property.

6. Such other evidence as the Collector of Revenues may deem necessary to satisfy him of the financial standing or solvency of the corporation or company.

SEC. 2. Such corporation or joint stock company shall file a certificate with the Collector of Revenues, certifying that said corporation or joint stock company has consented to be sued in the Canal Zone upon all causes of action arising against it therein, and designating the Collector of Revenues, and his successors in office, to be its true and lawful attorney, upon whom all process in any such action may be served:

and it shall agree that any lawful process against it, served on such attorney shall constitute a valid service upon it, and that his authority shall continue in force so long as any liability against it remains outstanding in the Canal Zone.

Such power of attorney, and the vote authorizing its execution, duly certified and authenticated, shall be filed in the office of the Collector of Revenues, and a copy thereof, certified by him, shall be sufficient evidence thereof.

No corporation or joint stock company shall do business in the Canal Zone until such certificate is duly filed and the other provisions of this Order are complied with.

SEC. 3. Upon compliance with the conditions set out in the foregoing section of this Order and the payment of an annual fee, in advance, of \$50, to the Collector of Revenues, he shall issue to such corporation or company a certificate authorizing it to do business within the Canal Zone. Such certificate, however, shall be terminable by the direction of the Chief Executive of the Canal Zone, but if terminated without fault upon the part of the corporation or joint stock company, a proportionate rebate of the license fee will be made to such corporation or company.

SEC. 4. Any agent or person representing a corporation or joint stock company who does business in the Canal Zone before such corporation or company has complied with the provisions of this Order shall be subject to a fine not exceeding \$25, or imprisonment in jail not exceeding thirty days, and each day's business so done by such agent or person shall be considered a separate offense for the purpose of this Order.

SEC. 5. This Order shall not be held to modify the provisions of an Executive Order relating to insurance companies, dated March 12, 1907, effective July 1, 1907.

SEC. 6. This Order shall take effect sixty days from the date of its publication in *The Canal Record*.<sup>1</sup>

WOODROW WILSON.

THE WHITE HOUSE,  
March 20, 1913.

#### EXECUTIVE ORDER NO. 9.

By virtue of the authority vested in me by Section 5 of the Panama Canal Act, approved August 24, 1912, directing the President to "provide a method for the determination and adjustment of all claims arising out of personal injuries to employees thereafter occurring while directly engaged in actual work in connection with the construction, maintenance, operation or sanitation of the Canal, or of the Panama Railroad, or of any auxiliary canals, locks or other works necessary and convenient for the construction, maintenance, operation or sanitation of the Canal, whether such injuries result in death or not, and prescribe a schedule of compensation therefor," I hereby establish the following Order for the Canal Zone:

Section 1. The United States or the Panama Railroad Company shall pay compensation as hereinafter specified for personal injuries to their respective employees occurring after March 1st, 1913, while such employees are directly engaged in actual work in connection with the construction, maintenance, operation or sanitation of the Canal, or of the Panama Railroad, or of any auxiliary canals, locks or other works necessary and convenient for the construction, maintenance, operation or sanitation of the Canal, whether such injuries result in death or not; but no compensation shall be paid if the injury is caused (1) by the employee's intention to bring about the injury or death of himself or of another, or (2) by his intoxication.

Section 2. *Compensation the exclusive remedy.*—Except as provided in this order, the United States and the Panama Railroad Company shall not be liable for personal injury to or the death of an employee for which compensation is provided in Section 1 hereof.

Section 3. *Waiting period.*—During the first five days of disability resulting from the injury the employee shall not be entitled to compensation, except as provided in Section 9. No compensation shall at any time be paid for such period.

Section 4. *Total disability.*—If the injury results in total disability, there shall be paid to the employee a monthly compensation equal to fifty per cent. of his monthly pay. This compensation shall be paid during such disability, not exceeding a period of six years from the fifth day of disability of any kind resulting from the injury. After such period of six years there shall be paid to the employee during such disability a monthly compensation equal to not more than forty per cent. and not less than twenty-five per cent. of his monthly pay.

Section 5. *Partial disability.*—If the injury results in partial disability, there shall be paid to the employee a monthly compensation equal to fifty per cent. of the difference between his monthly pay and his wage earning capacity per month after the

<sup>1</sup> Published in *Canal Record* of April 9, 1913.

beginning of such partial disability. This compensation shall be paid during such disability for a period not exceeding six years from the fifth day of disability of any kind resulting from the injury. After such period of six years, there shall be paid to the employee during such disability a monthly compensation equal to not more than forty per cent. and not less than twenty-five per cent. of the difference between his monthly pay and his wage earning capacity per month after such period of six years.

Section 6. *Affidavit as to wages.*—After the beginning of partial disability the Governor of the Panama Canal may, from time to time, require the injured employee to make an affidavit as to the wages per month which he is receiving. In the statement of the wages the value of rent, board, lodging and other advantages received from the employer, which can be estimated in money, shall be taken into account. If the employee at any time fails to make such affidavit, he shall not be entitled to any compensation while such failure continues, and the period of such failure shall be deducted from the period during which compensation is payable to the employee.

Section 7. *Refusal to work.*—If the employee refuses to work after suitable work is furnished to or secured for him by the United States or the Panama Railroad Company he shall not be entitled to any compensation while such refusal continues, and the period of such refusal shall be deducted from the period during which compensation is payable to the employee.

Section 8. *Sick leave.*—If at the time disability begins the employee has to his credit any unused sick leave, he may, at his option, subject to the approval of the Governor of the Panama Canal, use such leave until exhausted. During such time no compensation shall accrue, and any period of sick leave allowed on account of such disability after the first five days of disability shall be deducted from the period of six years referred to in Sections 4 and 5.

Section 9. *Medical, etc., attendance.*—There shall be furnished to the injured employee reasonable medical, surgical and hospital services and supplies, unless the employee elects to furnish his own physician or to care for himself. If in the opinion of the Governor of the Panama Canal a surgical operation is necessary, either to save the life of the injured employee or to render the disability less serious, and the employee refuses to submit to such operation, he shall not be entitled to any compensation thereafter, but in case of his death, compensation shall be paid as hereinafter provided.

Section 10. *Transportation of injured employees.*—If in the opinion of the Governor of the Panama Canal it is not desirable to continue the injured employee in the service, such employee, as soon as he is able to travel, shall, in the discretion of the Governor of the Panama Canal, be furnished transportation to his home. If at the time of the injury the employee is on the Isthmus, the Governor of the Panama Canal may, in his discretion, suspend, for such period as such employee remains on the Isthmus after free transportation has been offered to him as herein provided, the compensation payable to such employee.

Section 11. *Death payments.*—If the injury results in death within six years, there shall be paid to the following persons for the following periods a monthly compensation equal to the following percentages of the deceased employee's monthly pay:

(A) *To the widow or widower if there is no child.*—If wholly dependent for support upon the deceased employee at the time of the death, thirty-five per cent. for a period of six years from the date of the death, unless before that time such widow or widower dies or marries; after such period of six years not less than twenty per cent. nor more than thirty per cent. until death or marriage; if partly dependent, the compensation shall be a proportionate amount of the above compensation.

(B) *To the widow or widower if there is a child.*—The compensation payable under Clause A, and in addition thereto ten per cent. for each child, not to exceed a total of fifty per cent. for self and children; after the expiration of six years from the date of the death the total for self and children shall not exceed twenty-five to forty per cent. Compensation payable on account of any child shall cease when he dies, marries, or reaches the age of eighteen, or if over the age of eighteen and incapable of self-support becomes capable of self-support.

(C) *To the children if there is no widow or widower.*—Twenty-five per cent. for one child and ten per cent. additional for each additional child not to exceed a total of fifty per cent. divided among such children share and share alike. After the expiration of six years from the date of the death of the deceased employee, the total shall not exceed twenty-five to forty per cent. The compensation of each child shall be paid until he dies, marries or reaches the age of eighteen years, or if over the age of eighteen and incapable of self-support, becomes capable of self-support.

(D) *To the parents, if there is no widow, widower or child.*—If one is wholly dependent for support upon the deceased employee at the time of his death and the other is not dependent to any extent, twenty-five per cent; if both are wholly dependent, twenty per cent. to each; if one is or both are partly dependent a proportionate amount in the

discretion of the Governor of the Panama Canal. This compensation shall be paid for a period of eight years from the time of the death, unless before that time the parent dies, marries or ceases to be dependent.

(E) *To the brothers, sisters, grandchildren and grandparents, if there is no widow, widower, child or dependent parent.*—If one is wholly dependent upon the deceased employee for support at the time of the death, twenty per cent.; if more than one are wholly dependent, thirty per cent., divided among them share and share alike. If there is no one of them wholly dependent, but one or more are partly dependent, ten per cent. divided among them share and share alike. The compensation of each beneficiary shall be paid for a period of eight years from the time of the death unless before that time he, if a grandparent dies, marries or ceases to be dependent, or, if a brother, sister or grandchild, dies, marries or reaches the age of eighteen years, or if over that age and incapable of self-support becomes capable of self-support.

(F). As used in this section, the term "child" and "children" include step-children, adopted children, posthumous children and illegitimate children, but do not include married children. The terms "brother" and "sister" and their plurals include stepbrothers and stepsisters, half-brothers and half-sisters, and brothers and sisters adopted by the parent of the deceased employee, but do not include married brothers and married sisters. The terms "grandchild" and "grandchildren" include children of adopted children, and children of stepchildren, but do not include step-children of children, step-children of stepchildren, stepchildren of adopted children or married grandchildren. All of the above terms include only persons under eighteen years of age or over that age and incapable of self-support. The terms "parent" and "parents" include step-parents and the parents by whom the deceased employee was adopted. The terms "grandparent" and "grandparents" include the parents of the parents by whom the deceased employee was adopted, but do not include parents of step-parents, step-parents of parents, or step-parents of step-parents. The term "widow" and "widower" include only the decedent's wife or husband actually dependent upon him or her for support at the time of the death.

(G) The period during which compensation was payable to the deceased employee before his death shall be deducted from the period of six years referred to in Clauses A, B, and C, and from the period of eight years referred to in Clauses D and E.

(H) Upon the cessation of compensation under this section to or on account of any person, the compensation of the remaining persons entitled to compensation for the unexpired part of the period during which their compensation is payable, shall be that which such persons would have received if they had been the only persons entitled to compensation at the time of the decedent's death.

Section 12. *Burial expenses.*—If the employee dies as a result of the injury away from his home, office or outside of the United States and compensation has not ceased, his body shall, if practicable, or if desired by his relatives, and if transportation has not been furnished the employee under Section 10 before his death, be embalmed and transported in a hermetically sealed casket to the home of the employee if such home is within the United States. If death occurs on the Isthmus and the body is not transported away from the Isthmus, the body shall be interred on the Isthmus at the expense of the United States or of the Panama Railroad.

Section 13. *Computation of pay.*—If the monthly pay of the employee is over two hundred dollars a month, the monthly pay shall be considered to be two hundred dollars. Subject to this maximum, the monthly pay shall be computed as follows:

(A) If the employee is paid by the year divide his yearly pay at the time of the injury by twelve;

(B) If the employee is paid by the month, take his monthly pay at the time of the injury;

(C) If the employee is paid by the week, multiply his weekly pay at the time of the injury by fifty-two and divide the results by twelve;

(D) If the employee is paid by the day, multiply his daily pay at the time of the injury by twenty-six;

(E) If the employee is paid by the hour, multiply his hourly pay at the time of the injury by the number of hours constituting a day's work and multiply the result by twenty-six;

(F) If the employee is paid by his output; find his hourly pay at the time of the injury by dividing the total amount earned by him in the employment in which and at the rate of pay at which he was employed at the time of the injury, during so much of the thirty days next preceding the injury, including the day of the injury, as he was so employed, by the number of hours so employed during such thirty days, then proceed as in (E);

(G) In making the computation provided in Clauses (E) and (F) of this section, overtime shall not be taken into account;

(H) Subsistence shall be included as part of the pay.



Section 14. *Commutation of periodical payments.*—If the monthly payments to the beneficiary are less than Five dollars per month, or if the beneficiary is not a citizen of the United States, or is or is about to become a non-resident of the United States, or if the Governor of the Panama Canal determines that it is for the best interests of the beneficiary, the liability of the United States or of the Panama Railroad Company for compensation to such beneficiary shall be discharged by the payment of a lump sum equal to two-thirds of all future payments of compensation. The probability of the beneficiary's death before the expiration of the period during which he is entitled to compensation, shall be determined according to the American Table of Mortality. The probability of the happening of any other contingency affecting the amount or duration of the compensation shall be disregarded.

Until such time as the President, under the authority of Section 4 of the Act of August 24, 1912, entitled "An Act to provide for the opening, maintenance, protection and operation of the Panama Canal and the sanitation and government of the Canal Zone," shall discontinue the Isthmian Canal Commission, compensation shall be paid in a lump sum in all cases, unless the Chairman of the Isthmian Canal Commission in any case determines that payment in instalments for any part or all of the period during which compensation is payable is for the best interests of the United States or of the Panama Railroad Company or of the beneficiary.

Section 15. Payment of the compensation shall be made to the beneficiary or to such representative as the Governor of the Panama Canal may determine.

Section 16. *Determination of wage earning capacity.*—In the determination of the employee's wage earning capacity after the beginning of partial disability the value of rent, board, lodging and other advantages which are received from his employer and which can be estimated in money, shall be taken into account.

Section 17. *Notice of injury or death.*—Immediately after the injury, the injured employee or some one on his behalf shall give to the immediate superior of such employee a written notice of the injury, and if the injury results in the death of the employee, one of the persons entitled to compensation or some person on his behalf, within 90 days thereafter, shall give to the immediate superior of such employee or to the Governor of the Panama Canal a written notice of such death. The notice shall state the name of the employee, his class of service, the year, month, day and hour when and the particular locality where the injury or death occurred, the cause of the injury or death, the nature of the injury, the nature and extent of the disability resulting therefrom, and the address of the employee and of the person giving the notice. The notice may be given personally or sent by mail. The Governor of the Panama Canal may, in his discretion, waive the giving of a notice.

Section 18. *Report of injury or death.*—Immediately after an injury to an employee resulting in his death or in his probable disability, the immediate superior of the employee shall at once make a report to the Governor of the Panama Canal, containing such information as the Governor of the Panama Canal may, by regulation, require.

Section 19. *Claim for compensation.*—No compensation under this order shall be allowed to any person unless he, or some on his behalf, shall make a written claim therefor upon the Governor of the Panama Canal within the time specified in Section 21. The claim may be served personally upon or sent by mail to the Governor of the Panama Canal or to such person as he may, by regulation, require.

Section 20. *Contents of claim.*—The claim shall be signed by the person making the claim and shall state the name of the employee, his age, sex, nationality and class of service, the year, month, day and hour when and the particular locality where the injury or death occurred, the cause of the injury or death, the nature of the injury, the nature and extent of the disability resulting therefrom; the monthly pay of the employee at the time of the injury, the relationship of the person entitled to compensation to the employee, the names and addresses of all persons entitled to compensation on account of such injury or death, the amount and duration of the compensation claimed, and the address of the person making the claim. The claim shall be sworn to by the person entitled to compensation or by the person acting on his behalf, and, except in case of death, or as otherwise provided in regulations prescribed by the Governor of the Panama Canal, shall be accompanied by a certificate of the employee's physician, if any, stating the nature of the injury, and the nature and extent of the disability. The claim shall, wherever possible, be made on forms furnished by the Governor of the Panama Canal, and in addition to the statements above required, shall contain such other information as the Governor of the Panama Canal may require.

The Governor of the Panama Canal may waive the making of and swearing to claims and the inclusion therein of any of the above requirements in such cases as he may deem proper.

Section 21. *Time within which claim must be made.*—Claims for compensation shall be made within sixty days after the injury, or, in case of death, within one year after the

death. For any reasonable cause shown, the Governor of the Panama Canal may allow claim for injury to be filed within one year after the injury.

Section 22. *Amendment of claim.*—The Governor of the Panama Canal may, after receipt of the claim, demand a further claim specifying in the demand in what particular the claim is defective. Failure to make such demand shall constitute a waiver by the United States or by the Panama Railroad Company, as the case may be, of all defects which the claim may contain. After receipt of such demand, the person making the claim may, at any time within 60 days, make an amended claim which shall supersede the first claim and have the same effect as an original claim.

Section 23. *Medical examination.*—After the injury and during disability the employee shall as frequently and at such times and places as may be reasonably required submit himself to examination by a medical officer of the United States or by a duly qualified physician designated by the Governor of the Panama Canal and paid by the United States or by the Panama Railroad Company, as the case may be. The employee may have a duly qualified physician designated and paid by him present to participate in such examination. For all examinations after the first, the employee shall, in the discretion of the Governor of the Panama Canal, be paid his reasonable travelling and other expenses and loss of wages incurred in order to submit to such examination. If the employee refuses to submit himself for or in any way obstructs any examination, his right to claim compensation under this order shall be suspended until such refusal or obstruction ceases. No compensation shall be payable while such refusal or obstruction continues and such period shall be deducted from the period for which compensation would otherwise be payable.

Section 24. *Disagreement between physicians.*—In case of any disagreement between the physician making an examination on the part of the United States or the Panama Railroad Company and the employee's physician, the Governor of the Panama Canal shall appoint a third physician, duly qualified. The decision of the majority shall be final. A reasonable fee shall be allowed and paid by the United States or by the Panama Railroad Company, as the case may be, to such third physician if he is not a medical officer of the United States.

Section 25. *Assignment of right against third person.*—If an injury or death for which compensation is payable under this order is caused under circumstances creating a legal liability in some person other than the United States or the Panama Railroad Company to pay damages therefor, no compensation shall be payable to any beneficiary for such injury or death until he assigns to the United States or to the Panama Railroad Company, as the case may be, any right of action which he may have to enforce such liability of such other person, or any right which he may have to share in any money (or other property) received in satisfaction of such liability of such other person. The United States or the Panama Railroad Company, as the case may be, if it prosecutes such right to judgment or settlement shall after deducting the amount of any compensation already paid to the beneficiary and the costs of such prosecution, pay over to the beneficiary any surplus remaining. Such surplus so paid over shall be credited on future instalments of compensation as they become due. The Governor of the Panama Canal may waive the requirement of such assignment or may waive it for such period as he may deem proper.

Section 26. *Assignment of right against Panama Railroad Company.*—If an injury or death for which compensation is payable under this order is caused under circumstances creating a legal liability in the Panama Railroad Company to pay damages therefor under the laws of any State, Territory, or possession of the United States or of the District of Columbia or of any foreign country, no compensation shall be payable to any beneficiary for such injury or death until he releases to the Panama Railroad Company, any right of action which he may have to enforce such liability of the Panama Railroad or until he assigns to the United States or to the Panama Railroad Company, as the case may be, any right which he may have to share in any money (or other property) received in satisfaction of such liability of the Panama Railroad Company. The Governor of the Panama Canal may waive the requirement of such assignment or release for such period as he may deem proper.

Section 27. *Assignments and attachments.*—No claims for compensation under this order shall be assignable, and all compensation and claims therefor shall be exempt from all claims of creditors. This section is hereby constituted a part of the Laws of the Canal Zone.

Section 28. *Attorneys' fees.*—No claim for legal services in connection with any claim arising under this order shall be enforceable unless approved by the Governor of the Panama Canal. This section is hereby constituted a part of the Laws of the Canal Zone.

Section 29. *Modification of allowance of compensation.*—The Governor of the Panama Canal may at any time review, and, in accordance with the facts found in such review, end, diminish, or increase any compensation previously fixed or determined.

Section 30. *Recovery of compensation erroneously paid.*—If any compensation is paid under mistake of law or of fact the Governor of the Panama Canal shall immediately cancel any order under which such compensation has been paid, and shall recover, as far as practicable, any amount which has been so paid.

Section 31. *Powers of Governor of the Panama Canal.*—The Governor of the Panama Canal shall make all necessary rules and regulations for the proper, effective, and economical enforcement of this order, and shall decide all questions arising under this order or in regard to the interpretation thereof. His determination of any fact necessary to or underlying any claim hereunder, shall be final and conclusive upon all parties and claimants or beneficiaries.

Section 32. *Powers of Chairman of Isthmian Canal Commission.*—Until such time as the President, under the authority of section 4 of the Act of August 24, 1912, entitled "An act to provide for the opening, maintenance, protection and operation of the Panama Canal, and the sanitation and government of the Canal Zone" shall discontinue the Isthmian Canal Commission, and until the Governor of the Panama Canal is appointed and has qualified, all the rights, powers and duties vested in the Governor of the Panama Canal by this order shall be exercised by the Chairman of the Isthmian Canal Commission.

Section 33. *Penalty for false swearing.*—Whoever shall make in any affidavit required under section 6 or in any claim required by section 19, any statement, knowing it to be false, shall be deemed guilty of perjury and shall be punished by a fine of not more than \$5,000, or by imprisonment for not more than 2 years, or by both such fine and imprisonment. This section is hereby constituted a part of the Laws of the Canal Zone.

Section 34. *Singular and masculine.*—Wherever used in this order the singular includes the plural and the masculine gender includes the feminine and neuter.

Section 35. *Liability of United States and of Panama Railroad Company.*—If the payment of compensation under this order on account of an injury or death is to be made from the funds of the United States, the Panama Railroad Company shall be released and discharged from all liability on account of such injury or death, and if it is to be made from the funds of the Panama Railroad Company the United States shall be released and discharged from all liability on account of such injury or death. This section is hereby constituted a part of the Laws of the Canal Zone.

Section 36. *Repeal of Laws of Canal Zone.*—All laws of the Canal Zone inconsistent with any of the provisions of this order are hereby repealed. This section is hereby constituted a part of the Laws of the Canal Zone.

Section 37. *Time of taking effect.*—This order shall take effect March 1, 1913.<sup>1</sup>

THE WHITE HOUSE,  
February 26th, 1913.

WM H TAFT

#### EXECUTIVE ORDER NO. 10.

*To provide maritime quarantine regulations for the Canal Zone and the harbors of the cities of Panama and Colon, Republic of Panama.*

Whereas the official opening of the Panama Canal will require a revision of the maritime quarantine regulations for the Canal Zone and the harbors of the cities of Panama and Colon, Republic of Panama, and

<sup>1</sup> NOTE.—The operation of this order has been suspended by the provisions of the following Executive Order:

WHEREAS, an Executive Order was promulgated on February 26, 1913, providing a method of compensation for personal injuries to, or for the death of, employees of the Isthmian Canal Commission and of the Panama Railroad Company, and no appropriation has been made available for the payment of compensation under the terms of such Order;

AND WHEREAS, the provisions for the payment of claims for injuries to, or for the death of, employees of the Isthmian Canal Commission and of the Panama Railroad Company, in force prior to the time of the promulgation of said Order of February 26, 1913, should continue until the Order just mentioned can be made effective;

By virtue of the authority vested in me,  
IT IS ORDERED, That the operation of the said Order of February 26, 1913, is hereby suspended until further executive order or direction in the premises;

AND IT IS FURTHER ORDERED, That, until such further order or direction, payment of compensation for injuries to, or for the death of, employees of the Isthmian Canal Commission and of the Panama Railroad Company, occurring after February 26, 1913, shall, as before that date, continue to be made in accordance with the Act of Congress, approved May 30, 1908 (35 Stat. 556), being "An Act Granting to certain employees of the United States the right to receive from it compensation for injuries sustained in the course of their employment," the Act of Congress, approved February 24, 1909 (35 Stat. 645), being "An Act Relating to injured employees on the Isthmian Canal," Section 5 of the Act of Congress, approved March 4, 1911, being "An Act Making appropriations for sundry civil expenses of the government for the fiscal year ending June thirtieth, nineteen hundred and twelve, and for other purposes," the laws of the Canal Zone, and the rules and regulations heretofore made in regard thereto.

THE WHITE HOUSE,  
March 24, 1913.

WOODROW WILSON

Whereas the Government of the United States and the authorities of the Canal Zone are authorized to establish such rules and regulations for the ports and harbors of said cities, by virtue of the second paragraph of Article VII of the treaty between the United States and the Republic of Panama for the construction of the Isthmian Canal, signed November 18, 1903, which paragraph reads as follows:

"The Republic of Panama agrees that the cities of Panama and Colon shall comply in perpetuity with the sanitary ordinances whether of a preventive or curative character, prescribed by the United States and in case the Government of Panama is unable or fails in its duty to enforce this compliance by the cities of Panama and Colon with the sanitary ordinances of the United States the Republic of Panama grants to the United States the right and authority to enforce the same," and section 6 of the Executive Order of December 3, 1904, known as the Taft Agreement made between the Secretary of War of the United States and the Chief Executive of the Republic of Panama, which section reads as follows:

"Section 6. This order shall also be inoperative unless the proper Governmental authorities of the Republic of Panama shall grant power to the authorities of the Canal Zone to exercise immediate and complete jurisdiction in matters of sanitation and quarantine in the maritime waters of the ports of Panama and Colon." and Article I of Decree No. 66 of December 6, 1904, issued by the President of Panama, agreeably to said Executive Order, and published in the Official Gazette No. 70, of 1904, which article reads as follows:

"Article I. The authorities of the Canal Zone are empowered to exercise freely, immediate and complete jurisdiction in all matters of sanitation and quarantine in the waters of the ports of Panama and Colon. In consequence, the authorities of the Republic shall proceed in conformity with the provisions of this decree to the end that these may be strictly complied with."

By virtue of the authority vested in me and in conformity with the foregoing treaty provision and the Executive Order and Presidential Decree above mentioned, I hereby establish the following maritime quarantine regulations for the Canal Zone and for the harbors of the cities of Panama and Colon, Republic of Panama:

#### BILLS OF HEALTH

Section 1.—Masters of vessels clearing from any foreign port or from any port in the possessions or other dependencies of the United States for a port in the Canal Zone or for the ports of Panama or Colon, Republic of Panama, must obtain an original bill of health in duplicate from the officer or officers authorized by the quarantine laws and regulations of the United States to sign such certificates for vessels entering the ports of the United States.

The following form is prescribed for such bills of health:

Form No. ———

#### CANAL ZONE.

##### *Original bill of health*

I, ——— (the person authorized to issue the bill, at the port of ———), do hereby state that the vessel hereinafter named clears from the port of ——— under the following circumstances:

Name of vessel, ———. Nationality, ———. Rig, ———. Master, ———. Tonnage, gross, ———; net, ———. Iron or wood, ———. Number of compartments for cargo, ———; For steerage passengers, ———. For crew, ———.

Name of medical officer, ———.

Number of officers, ———; of crew, including petty officers, ———; of passengers, first cabin, ———; second cabin, ———; steerage, ———. Officers' families, ———. Total number of persons on board, ———.

Passengers destined for the Canal Zone or the city of Panama or Colon, ——— first cabin, ——— second cabin, ——— steerage.

Previous port, ———.

Number of cases of sickness, and character of same, during last voyage, ———.

Number of cases of sickness, and character of same, while vessel was in this port, ———.

Vessel engaged in ——— trade, and plies between ——— and ———.

Nature, sanitary history, and condition of cargo, ———.

Source and wholesomeness of water supply, ———.

Source and wholesomeness of food supply, ———.

Sanitary history and health of officers and crew, ———.

Sanitary history and health of passengers, cabin, ———.

Sanitary history and health of passengers, steerage, ———.

Sanitary history and condition of their effects, \_\_\_\_\_.  
 Location of vessel while in port—wharf, \_\_\_\_; open bay, \_\_\_\_; distance from shore, \_\_\_\_.  
 Time vessel was in port, \_\_\_\_.  
 Character of communication with shore, \_\_\_\_.  
 Sanitary condition of vessel, \_\_\_\_.  
 Sanitary measures, if any, adopted while in port, \_\_\_\_.  
 Sanitary condition of port and vicinity, \_\_\_\_.  
 Prevailing diseases at port and vicinity, \_\_\_\_.  
 Malaria, \_\_\_\_ deaths during month of \_\_\_\_.  
 Number of cases and deaths from the following-named diseases during the past two weeks, ending, \_\_\_\_\_.

Diseases	No. of cases	No. of deaths
Yellow fever Asiatic cholera Cholera nostras or cholerae Smallpox Typhus fever Plague Leprosy		

## Remarks.

Any condition affecting the public health existing in the port of departure or vicinity to be here stated.

When there are no cases or deaths, entry to that effect must be made.

I certify that the vessel has complied with the Quarantine Rules and Regulations made under the act of February 15, 1893, and that the vessel leaves this port bound for \_\_\_\_\_, Canal Zone, or \_\_\_\_\_, Republic of Panama, via \_\_\_\_\_.

Given under my hand and seal this \_\_\_\_\_ day of \_\_\_\_\_, 191-.

(SEAL)

(Signature of Consular Officer) \_\_\_\_\_.

Section 2.—Vessels clearing from any foreign port or from any port in the possessions or other dependencies of the United States for a port in the Canal Zone or for the port of Panama or Colon, Republic of Panama, and entering or calling at intermediate ports, must procure at all said ports a supplemental bill of health in duplicate, from the officer or officers authorized by the quarantine laws and regulations of the United States to sign such certificates for vessels entering the ports of the United States. If a quarantinable disease has appeared on board the vessel after leaving the original port of departure, or other circumstances presumably render the vessel infected, the supplemental bill of health should be withheld until such sanitary measures have been taken as are necessary.

The following form is prescribed for supplemental bills of health:

## CANAL ZONE

*Supplemental bill of health*

Vessel \_\_\_\_\_, bound from \_\_\_\_\_ to \_\_\_\_\_, Canal Zone, or \_\_\_\_\_, Republic of Panama. Port of \_\_\_\_\_.

Sanitary condition of port and vicinity \_\_\_\_\_.

Prevailing diseases at port and vicinity \_\_\_\_\_.

Malaria \_\_\_\_\_ deaths during month of \_\_\_\_\_.

Number of cases and deaths from the following-named diseases during the past two weeks, ending \_\_\_\_\_.

Diseases	No. of cases	No. of deaths	Remarks. (Any condition affecting the public health existing in the port to be stated here. When there are no cases, or deaths, entry to that effect must be made.)
Yellow fever Asiatic cholera Cholera nostras, or cholerae Smallpox Typhus fever Plague Leprosy			

Number and sanitary condition of passengers and crew landed at this port:

First cabin, No. —; sanitary history and condition, —.

Second cabin, No. —; sanitary history and condition, —.

Steerage, No. —; sanitary history and condition, —.

Crew, No. —; sanitary condition and history, —.

NOTE.—If any passenger or member of crew disembarked on account of sickness, state disease.

Number and sanitary condition of passengers and crew taken on at this port, and sanitary condition of effects:

First cabin, No. —; sanitary condition and history, —.

Second cabin, No. —; sanitary condition and history, —.

Steerage, No. —; sanitary condition and history, —.

Number of passengers for Canal Zone: — first cabin, — second cabin, — steerage.

Number of passengers for Republic of Panama: — first cabin, — second cabin, — steerage.

Crew, No. —; sanitary condition and history, —.

Sanitary condition of effects, —.

Total passengers on board, —; total crew on board, —.

Sanitary measures, if any, adopted while in port, —.

Location of vessel while in port—wharf, —; open bay, —; distance from shore, —.

Time vessel was in port, —.

Character of communication with shore, —.

Nature, sanitary history, and condition of cargo taken on at this port, —.

(Cancel Form A, B, or C, as the case requires.)

Form.

(Form A will be used at intermediate ports where the vessel does not enter.)

A—To the best of my knowledge and belief—

B—I have satisfied myself that—

C—Since leaving —, the following quarantinable disease has appeared on board —, and I certify that the necessary sanitary measures have been taken.

I certify also that with reference to the passengers, effects, and cargo taken on at this port, the vessel has complied with the rules and regulations made under the act of February 15, 1893.

Given under my hand and seal this — day of — 191—.

(Signature of consular officer:)

(SEAL)

Section 3.—The master of a vessel entering the ports of the Canal Zone or the ports of Panama and Colon, Republic of Panama, from any port of the United States, must present to the Quarantine Officer and to the Custom Officer of the Canal Zone, or his authorized agent, each a bill of health signed by the customs officer of the port of the United States from which said vessel sails.

#### FOREIGN REGULATIONS.

*Inspection of vessels from foreign ports and ports in the dependencies of the United States.*

Section 4.—The officer issuing the bill of health shall satisfy himself, by inspection if necessary, that the conditions certified to therein are true, and is authorized to withhold the bill of health or the supplemental bill of health until he is satisfied that the vessel, the passengers, the crew, and the cargo have complied with these regulations.

Section 5.—Inspection is required of—

(a) All vessels from ports in which cholera, yellow fever, or plague in men or rodents prevails, or at which smallpox or typhus fever prevails in epidemic form, and at which a medical officer is detailed.

(b) All vessels carrying steerage passengers; but need only include the inspection of such passengers and their living apartments, if sailing from a healthful port.

(c) Inspection of the vessel is such an examination of the vessel, cargo, passengers, crew, personal effects of same, including examination of manifests and other papers,

food and water supply, the ascertainment of its relations with the shore, the manner of loading and possibilities of invasion by rats and insects as will enable the inspecting officer to determine if these regulations have been complied with.

(d) When an inspection is required, it should be made by daylight, as late as practicable before sailing. The vessel should be inspected before the passengers go aboard, the passengers just before embarkation, and the crew on deck, and no communication should be had with the vessel after such inspection except by permission of the officer issuing the bill of health.

#### GENERAL REQUIREMENTS.

Section 6.—Vessels, prior to stowing cargo or receiving passengers, should be mechanically clean in all parts, especially the hold, forecastle and steerage.

Section 7.—Any portions of the vessel liable to have been infected by any communicable disease should be disinfected before the issuance of the bill of health.

Section 8.—Street sweepings, city cleanings, or anything containing organic refuse should not be taken as ballast from any port.

Section 9.—Bedding, upholstered furniture, soiled wearing apparel, personal effects, and secondhand articles of a similar nature, coming from a district known to be infected with cholera, smallpox, typhus fever, or as to the origin of which no positive evidence can be obtained, and which the consular or medical officer has reason to believe are infected, should be disinfected prior to shipment. In the case of typhus fever, the destruction of vermin should be assured. Articles similar to the above-mentioned, if from a district infected by plague, should be inspected, and, if necessary, disinfected and treated to destroy vermin.

Section 10.—Articles from an uninfected district shipped through an infected port may be accepted without restriction if not exposed to infection in transit.

Section 11.—Any article shipped from or through an infected port or place, and which the consul or medical officer has reason to believe infected, should be disinfected.

Section 12.—Any article presumably infected, which can not be disinfected, should not be shipped.

Section 13.—Passengers, for the purpose of these regulations, are divided into two classes, cabin and steerage.<sup>1</sup>

Section 14.—So far as possible passengers should avoid embarking at a port where quarantinable disease prevails, and communication between the vessel and the shore should be reduced to a minimum. In such a port the personnel of the vessel should remain on board during their stay.

Vessels carrying passengers from any port where quarantinable disease prevails in epidemic form should have a medical officer.

Section 15.—No person suffering from a quarantinable disease, or scarlet fever, measles, diphtheria, or other communicable disease, should be allowed to ship.

Section 16.—All baggage of steerage passengers destined for the Canal Zone, or the ports of Panama or Colon, Republic of Panama, should be labeled. If the baggage is in good sanitary condition, the label shall be a red label bearing the name of the port, the vessel on which the baggage is to be carried, the word "passed" in large type, the date of inspection, and the seal or stamp of the consular or medical officer of the United States. All baggage that has been disinfected shall bear a yellow label, upon which shall be printed the name of the port, the vessel upon which the baggage is to be carried, the word "disinfected" in large type, the date of disinfection, and the seal or stamp of the consular or medical officer of the United States. It is understood, and it will be so printed on the blank, that the label is not valid unless bearing the consular or medical officer's stamp or seal.

Section 17.—Each steerage passenger shall be furnished with an inspection card as follows. This card, stamped by the consular or medical officer, is to be issued to every member of a family as well as to the head thereof, and shall be in the following form:

#### Inspection Card

(Immigrants and steerage passengers)

Port of departure ———. Date of departure ———.  
 Name of ship ———. Last permanent residence ———.  
 Name of immigrant ———.

<sup>1</sup> The sanitary measures applicable to second-cabin passengers will be those designated for first cabin passengers or for steerage passengers, according as the arrangements of their quarters and accommodations aboard, both sanitary and for association, class them in the opinion of the inspecting officer with the first cabin or steerage.

Inspected and passed at	Passed at quarantine, port of	
.....	Canal Zone (or)	Vaccinated
(Seal or stamp of consular or medical officer)	Republic of Panama	(Signature or stamp)
	(Date)	

(The following to be filled in by ship's surgeon or agent prior to or after embarkation.)  
Ship's list or manifest ———. No. on ship's list or manifest ———.

Berth No.	Steamship inspection.	To be punched by ship's surgeon at daily inspection.
	Days	
.....	1st, 2 3 4 5 6 7 8 9 10, 11, 12, 13, 14	

Section 18.—Passengers and crews, merchandise and baggage, prior to shipment at a noninfected port, but coming from an infected locality, should be subject to the same restrictions as are imposed at an infected port.

#### Local inspection of vessels.

Section 19.—Vessels arriving at any of the ports of the Canal Zone or the cities of Panama and Colon, Republic of Panama, under the following conditions, shall be inspected by the quarantine officer of the port prior to entry:

(a) Vessels from the United States; (b) Vessels from foreign ports; (c) Vessels with sickness aboard; (d) Vessels from Panamanian ports where any quarantinable disease prevails; (e) Vessels from Panamanian ports carrying passengers or articles suspected by the quarantine officer as being capable of conveying the infection of a transmissible disease.

Section 20.—The limits of anchorage of vessels awaiting inspection and of vessels undergoing quarantine, shall be fixed from time to time by the Chief Sanitary Officer of the Canal Zone.

Section 21.—Every vessel subject to quarantine inspection shall be considered in quarantine until granted free pratique, and such vessels shall fly a yellow flag from the foremost head from sunrise to sunset and shall observe all the other requirements of vessels actually quarantined.

Section 22.—The captain or master of a vessel in quarantine shall allow no communication with his vessel except as provided for in these regulations, nor shall any water craft approach within 200 meters of any such vessel.

Section 23.—No person or article shall be allowed to leave a vessel in quarantine without written authority from the quarantine officer.

Section 24.—Towboats, or any vessel or boat having had communication with a vessel in quarantine shall be submitted, with their personnel, to such measures of sanitation as the quarantine officer may judge to be necessary.

Section 25.—No person, except such officers of the port as are required to do so by the nature of their duties, and the agent of the vessel, if such agent has the consent of the quarantine officer, shall go aboard any vessel subject to quarantine until such vessel has been granted free pratique. Any person going aboard prior to the issuance of free pratique shall be subject to the same restrictions as the personnel of the vessel if, in the opinion of the quarantine officer, this is necessary for the protection of the public health.

Section 26.—The quarantine officer, after his inspection of the vessel and its documents, shall decide whether said vessel, or its personnel, or passengers, or any article aboard said vessel is liable to convey any of the following diseases: plague, yellow fever, cholera, small-pox, typhus fever or leprosy; and, if so, such vessel shall be placed in quarantine and forbidden entry until the period of incubation of such diseases is past, and he shall take such measures in respect to the vessel, its passengers or personnel or cargo as, in his judgment, may be required to prevent the entry of such diseases into the Canal Zone or the cities of Panama or Colon, Republic of Panama.

Section 27.—Passengers boarding vessels from ports subject to quarantine will be required, in the discretion of the Chief Sanitary Officer of the Canal Zone, to present personal certificates from the officer authorized by these regulations to sign bills of health, certifying to their sanitary history and condition, provided due notice has been issued to the agents of the steamship companies on the Isthmus of Panama.



Section 28.—Every case of sickness aboard any vessel in the harbor shall be immediately reported by the master of the vessel to the quarantine officer, who shall see the case and take such sanitary measures as may be necessary.

Section 29.—The Chief Quarantine Officer shall have charge of the sanitation of the harbors and vessels lying therein and shall see that such measures are enforced as are necessary for the proper hygiene of vessels, their cargoes, and their personnel, whether in port or en route, and to prevent the vessels from being a source of danger to other vessels or to the port, and he is authorized to certify bills of health to vessels clearing from ports under his jurisdiction, setting forth in such bill of health the conditions of the port, vessel, cargo, passengers, and crew; and is authorized at the request of the master of any vessel to disinfect and otherwise place such vessel in a sanitary condition so that it may leave the port in free pratique and be able to make entry at the port of destination without further disinfection or detention in quarantine.

Section 30.—The quarantine officer shall make such charges for the disinfection of vessels and their cargoes, and for the transportation and subsistence of passengers while in quarantine as may be fixed from time to time by the Governor of the Canal Zone.

Section 31.—A certificate from the quarantine officer that a vessel has complied with all the quarantine regulations shall be required of every vessel subject to inspection, as a pre-requisite for customs entry or passage through the Canal.

Section 32.—Quarantine stations shall be established and maintained at such places as may be decided upon by the Chief Sanitary Officer of the Canal Zone, with the approval of the Governor.

Persons detained in quarantine under these regulations shall not be permitted to go outside the limits of the quarantine station until discharged therefrom by the quarantine officer and if any such person shall leave the quarantine station without being duly discharged therefrom he may be taken into custody by the quarantine officers wherever found and returned to the quarantine station and, in addition, he may be punished as hereinafter described.

No person except the Chief Sanitary Officer of the Panama Canal or his representative, the quarantine officers and employees and personnel of the station shall be permitted to enter in or upon a quarantine station without permission from the Chief Sanitary Officer or the Chief Quarantine Officer of the Panama Canal.

Section 33.—The Governor of the Panama Canal may establish from time to time such rules and regulations as he may deem necessary to execute this order.

Section 34.—Any person violating any of the provisions of these regulations shall be punished by a fine not exceeding \$500.00, or by imprisonment in jail not exceeding 90 days, or both, at the discretion of the Court.

Section 35.—The medical officers of the Canal Zone, duly clothed with authority to act as quarantine officers at any port or place within the Canal Zone and the ports of the cities of Panama and Colon, Republic of Panama, and when performing the said duties, are hereby authorized to administer oaths and take declarations thereunder in matters relating to the administration of the quarantine laws and regulations of the Canal Zone Government.

Section 36.—These regulations shall take effect from and after the date upon which the Panama Canal is officially and formally opened for use and operation, by proclamation of the President of the United States.

WOODROW WILSON

THE WHITE HOUSE,  
15 April, 1913.

#### EXECUTIVE ORDER NO. 11.

##### *Providing for trial by jury in the Canal Zone.*

Under authority vested in me by law, it is ordered:

1. *In all criminal prosecutions in the Canal Zone for felonies, the accused shall enjoy the right of trial by an impartial jury of the District in which the crime shall have been committed, to be chosen as follows:*<sup>1</sup>

2. The clerk of the circuit court, the district judge, and the tax collector<sup>2</sup> [deputy collector of revenues<sup>3</sup>] for the administrative district within the circuit in which the crime shall have been committed, shall constitute a jury commission for that circuit. In the second judicial district, the district judge and the tax collector<sup>2</sup> [deputy collector of revenues<sup>3</sup>] to be members of the jury commission shall be designated by the circuit

<sup>1</sup> Reads as amended by Executive Order dated June 30, 1913, to take effect on and after July 4, 1913.

<sup>2</sup> Reads as amended by Executive Order of March 31, 1908.

<sup>3</sup> Office of District Tax Collector abolished, and office of Deputy Collector of Revenues created by Executive Order of October 4, 1910. (C. Z. No. 32.)

judge, upon this order becoming effective and annually thereafter, or as often as a vacancy may occur in the jury commission.

3. Prior to the first day of the term of any circuit court, upon application of the prosecuting attorney, or by direction of the judge of the circuit in which the crime shall have been committed, the jury commission shall assemble and select the names of sixty male residents of the Canal Zone, between the ages of 21 and 65 years, in good standing and in full possession of their ordinary faculties, who shall have resided within the Canal Zone for not less than three months previously, and who shall be able to read, write, and understand the English language.

Attorneys-at-law, physicians, ministers of an established religion, members of the military, naval, and police forces, and officers of the Commission of the rank and above the rank of resident engineers, shall be exempt from jury service. The names of the persons so selected shall be written by one of the commissioners upon slips of paper, folded so as to conceal the names, in a uniform manner, and placed in a jury box.

4. Upon the first day of the term, unless an adjournment of the trial beyond the term shall be granted, the judge shall select from the jury box the names of thirty jurors to constitute the panel for the trial of the defendant. The said jurors shall thereupon be summoned by a written notice, served upon them by the marshal of the court, to attend at the trial of the defendant upon a day named. If it appear that any of the jurors whose names have been selected are absent from the Canal Zone, or incapacitated from other cause from attending as jurors, the judge, upon the application of the marshal, shall draw the names of other jurors and direct their summons until a panel of thirty jurors shall be assembled.

5. Upon calling the case for trial, twelve jurors shall be called to try the defendant in the order in which their names shall have been first drawn for summons by the circuit judge. Either side shall have the right to challenge any juror for cause, and, in addition thereto, the defendant and prosecuting attorney shall each have the right to challenge arbitrarily six of the said jurors. If the original panel of thirty shall be exhausted without securing twelve impartial jurors to try the defendant, the names of other jurors shall be drawn by the circuit judge from the jury box and such jurors summoned until the jury shall have been completed.

6. The jury so selected shall, under the instructions of the court, and in conformity with the procedure prevailing in the Federal Courts of the United States, determine whether, under the facts as proved, the defendant is guilty or not guilty. They shall conduct their deliberations in secret, and shall return a verdict of guilty or not guilty, which must be unanimous. Sentence shall be pronounced by the court.

7. The circuit judge shall have the discretion to require the jury to be kept together and apart from the public from the time they are sworn until their verdict shall be returned. If they be kept together, suitable provision shall be made by the marshal of the court for their subsistence and lodging. The jurors shall be allowed a jury fee of two dollars for each day actually summoned to court and engaged in the trial of a criminal action. The cost of subsistence and lodging of the jurors and the fees for the jurors' attendance shall be paid from the Treasury of the Canal Zone, upon a voucher duly approved by the circuit judge.

8. It shall in all cases be optional with defendants to be tried before a jury as provided for in this order, or under the procedure prescribed in Section 171, Act No. 15 of the Laws of the Canal Zone. The accused shall, however, in person or through his attorney, file a written statement with the clerk of the circuit court before which his trial is to take place, on the first day of the term for which the trial is set, stating the procedure by which he desires to be tried. The procedure having been once selected by the accused can not thereafter be changed, but must be followed with respect to any future trial of the accused for the same offense.

THEODORE ROOSEVELT.

THE WHITE HOUSE,  
February 6, 1908.

## APPENDIX V.

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### CHARTS SHOWING ORGANIZATION OF ISTHMIAN CANAL COMMISSION AND PANAMA RAILROAD CO., JULY, 1912.

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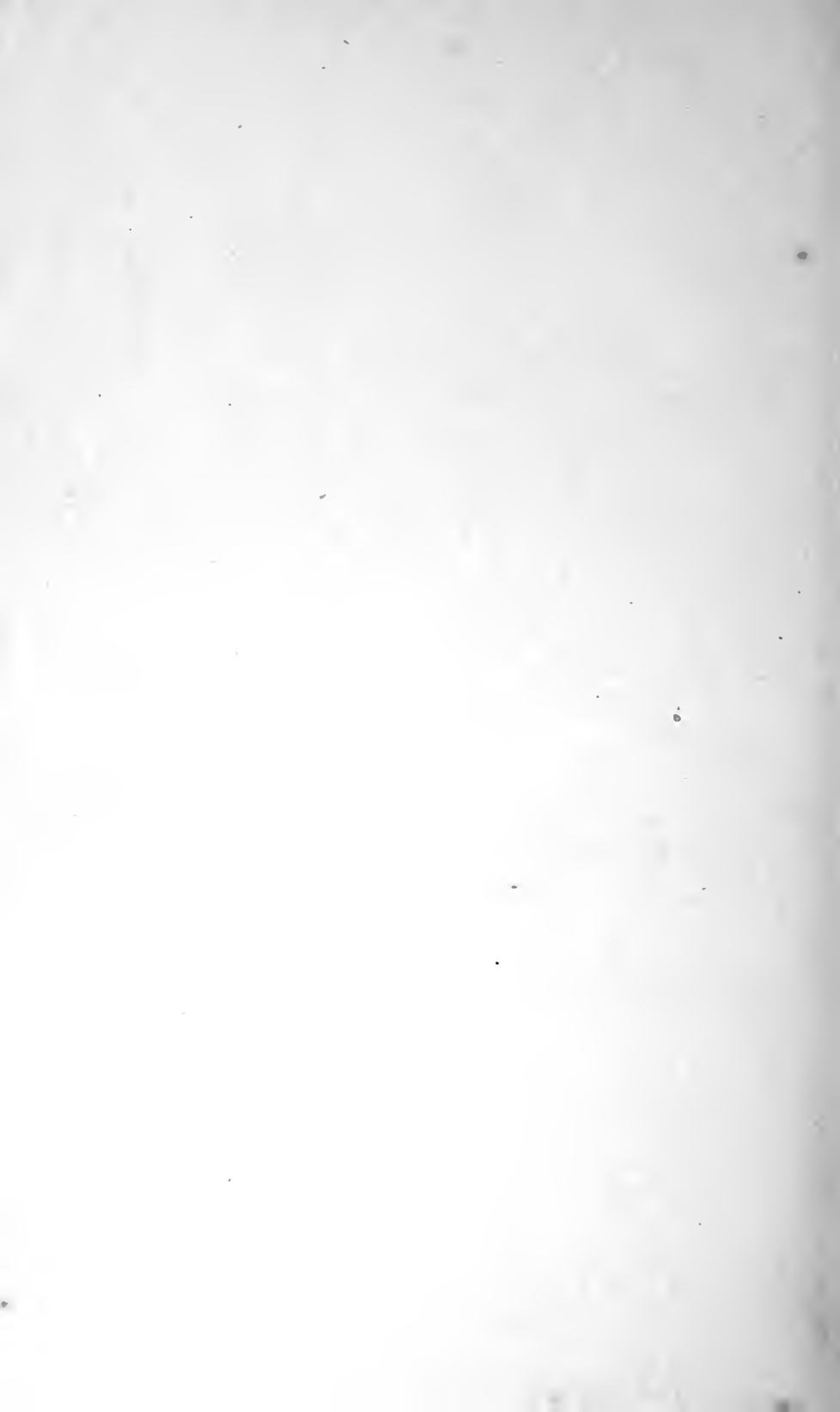
















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